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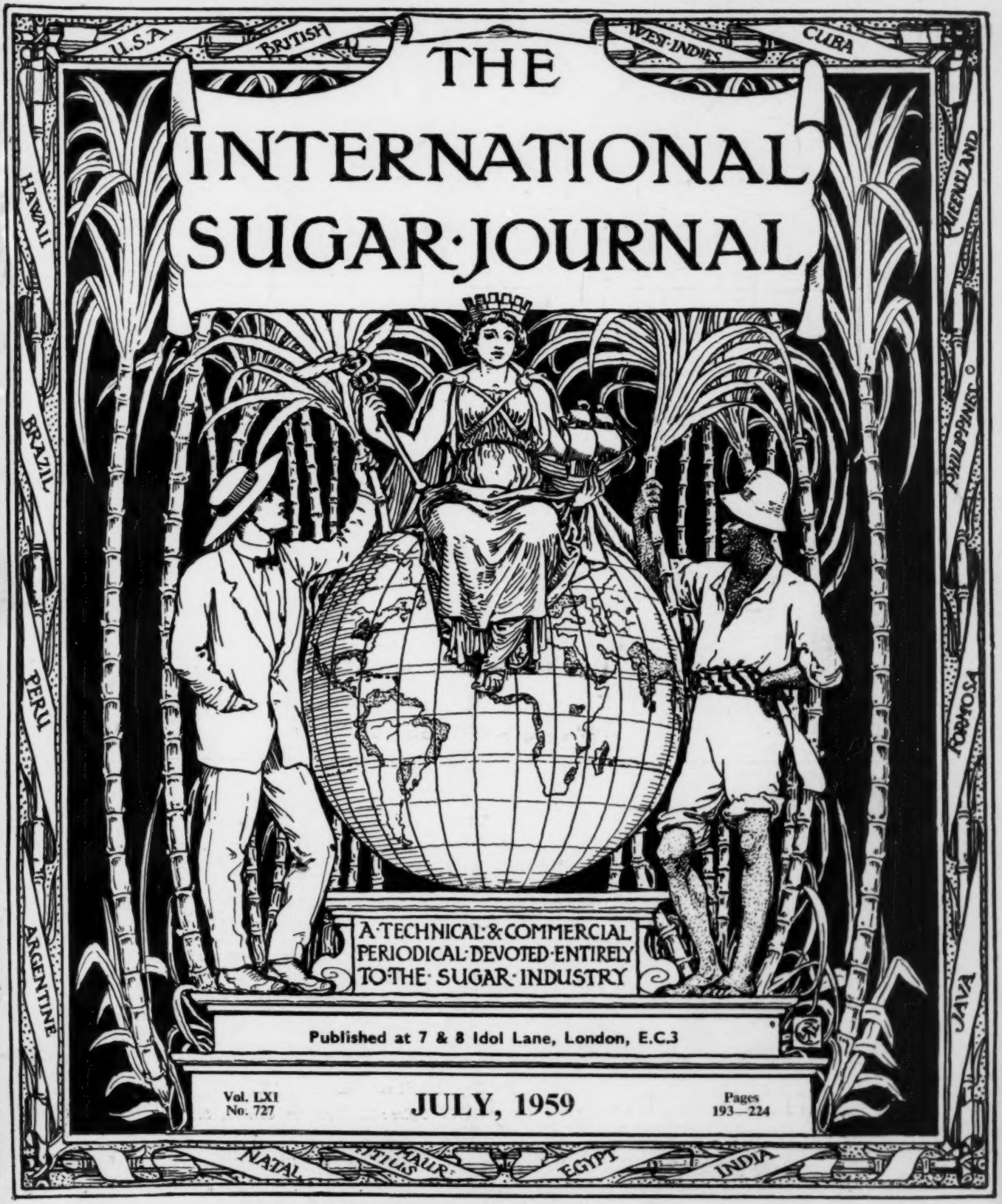

A·TECHNICAL·&·COMMERCIAL PERIODICAL·DEVOTED·ENTIRELY TO·THE·SUGAR·INDUSTRY

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Vol. LXI
No. 727

JULY, 1959

Pages
193—224

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6,867
TONS/CANE/DAY

Illustration shows an 18 Roll Turbine-Driven Tandem Supplied to the Rio Haina Sugar Company in the Dominican Republic for a nominal capacity of 5,000 TONS/CANE/DAY.

The Tandem is now grinding at the rate of 6,867 TONS/CANE/DAY and the photograph which was taken with the mills in operation illustrates strikingly the reduced number of operators required to run a modern Milling Tandem.

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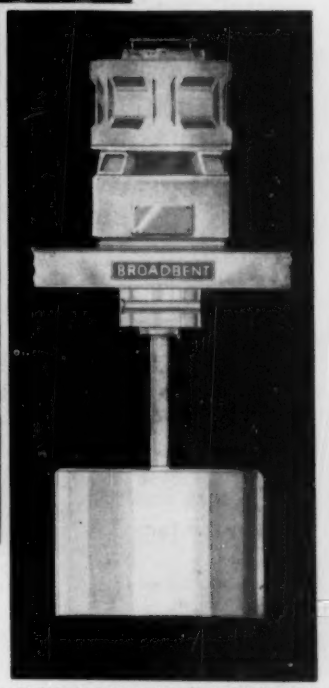

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A battery of six 42″ x 24″ centrifugals with 600/1200/1800 R.P.M. synchronous motors photographed during assembly and testing in our works prior to despatch to the LUABO factory of Sena Estates Ltd.

The machines are to be installed to cure C massecuites.

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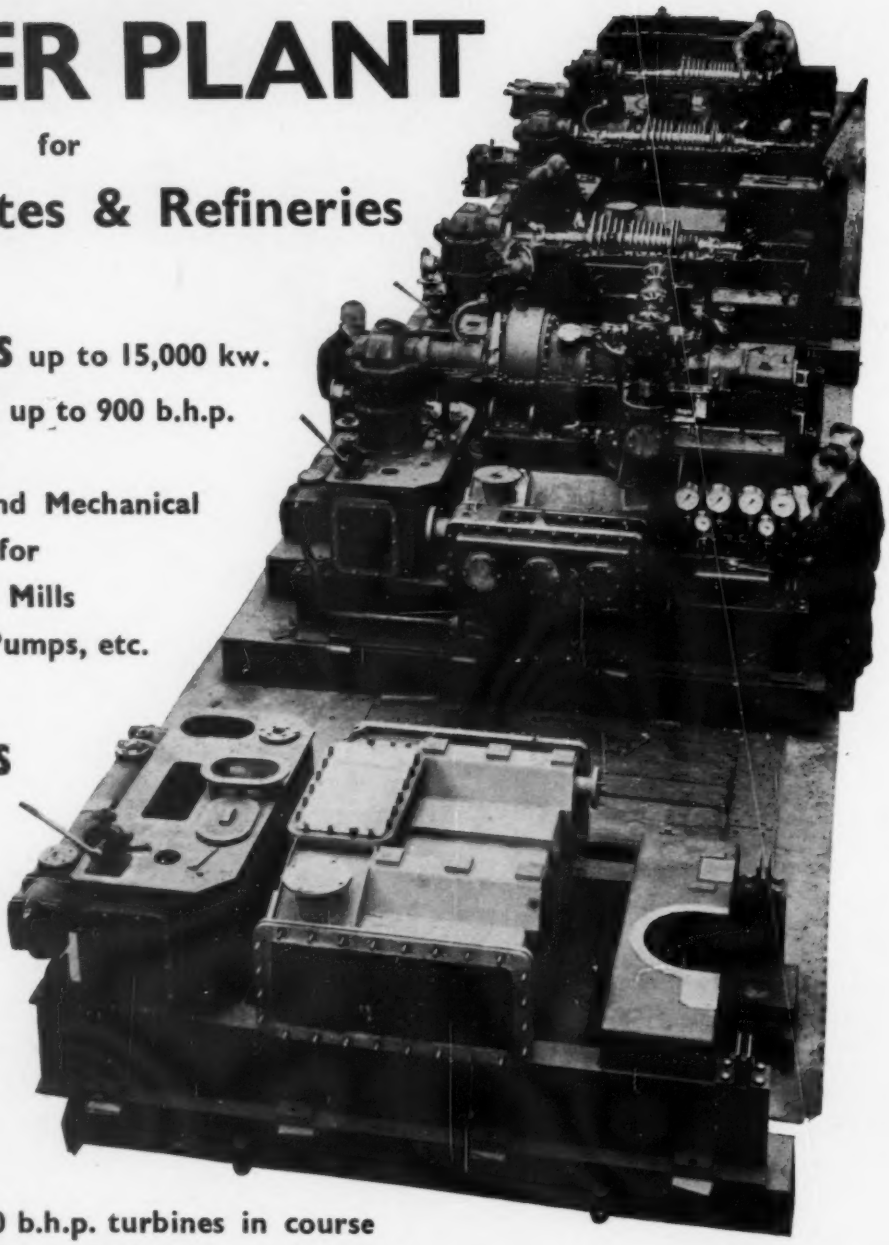

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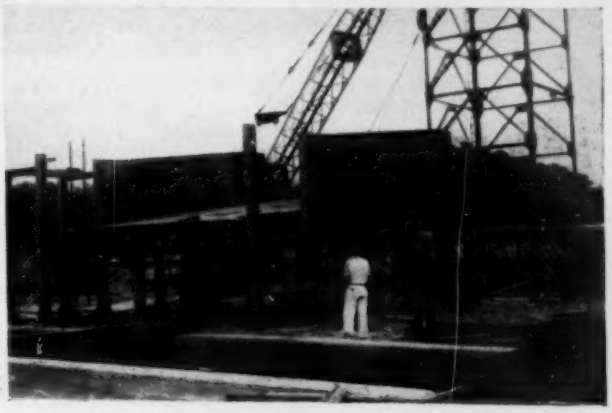
Even Feed...

. . . This first essential for good extraction is readily secured by the Mirrlees Feeding Table with levelling kickers.

The illustration shows an installation at a South American factory built and equipped by Mirrlees; the lower photograph was taken during construction. The Unloading Crane was also supplied by Mirrlees.



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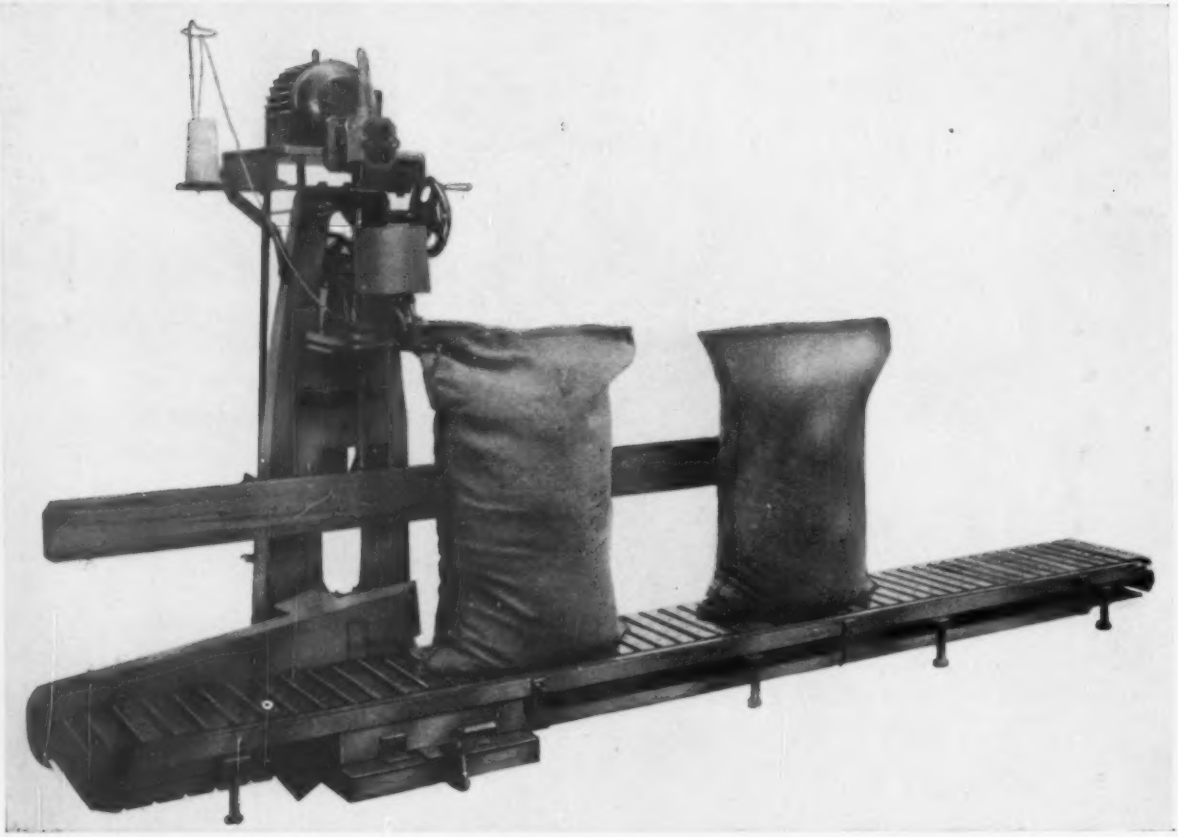
The 'Super' Universal Sack Closing Machine

MODEL NO. 5B

Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive



This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.

Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.

Machines can be seen working by appointment.

Power required 2 h.p. *Shipping weight : 14 cwts.*

Manufactured in Great Britain by :

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(Timewell's Patent)

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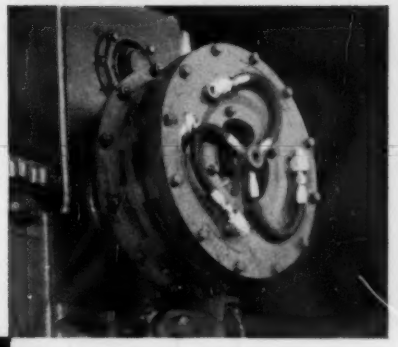
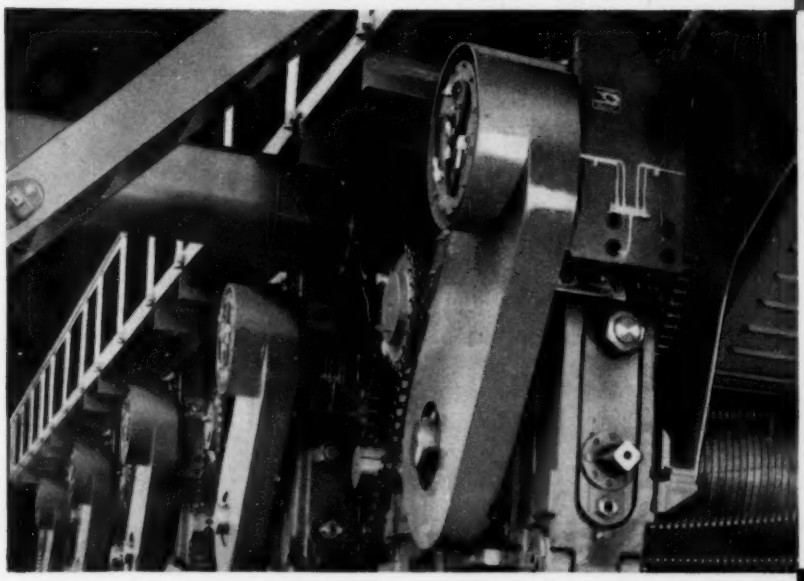
WICHITA AIR CLUTCHES

offer many advantages for improving control of intermediate carriers





- quick, smooth engagement of intermediate carrier drive
- control of clutches at individual mill permits immediate carrier stopping in case of chokes
- simple, safe operation through air valve control
- low maintenance—no lubrication or adjustments required
- optional centralized control of multiple number of clutches

Among recent contributions to ease of operation in milling is the Wichita air clutch. First adopted by Farrel in 1954, to improve carrier control, it has since been used in many successful installations. These include three of the largest tandems in the world.

More recently, Farrel has introduced the Wichita air clutch between the two gear units of a turbine drive, in place of a conventional coupling. This permits fast engagement of power. If the mill has to be stopped, the clutch is disengaged, the turbine continues to operate and turbine settings are not disturbed. In addition, air pressure can be adjusted to permit slippage at a predetermined point . . . preventing damage to mill or drive in event of excessive overloads.

Farrel is the sole representative for the Wichita air clutch for use on cane sugar grinding mills. Inquiries for their adoption to new or existing mills should be directed to

FARREL-BIRMINGHAM COMPANY, INC.
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FARREL
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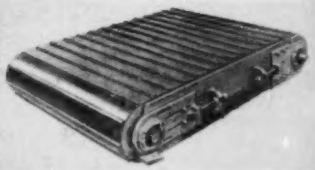
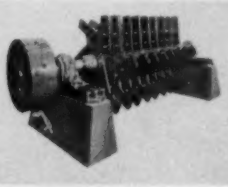
reflecting Farrel leadership in sugar mill design.



RUBBER-BELT CARRIERS
assure better retention of both bagasse and imbibition; positive cane feeding action; and there are no maintenance problems.



REVOLVING CANE KNIVES
provide high efficiency with economy in the preparation of any kind of hard or soft cane.

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1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.

Stainless steel vessel with mild steel jacket

12,000 gallon water separator

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Clark's modern methods, efficient equipment, unique facilities and practical approach all operate to your advantage....

Clarks offer you a unique combination of the most advanced equipment and methods with a century-old reputation for high craftsman standards on every type of fabrication work.

Stainless steel, mild steel, aluminium, copper; and aluminium-bronze to mild steel... Clarks of Hull will not only give you the practical solution to your problem—they'll deliver a first-class job on time!

Send that enquiry *first* to Clarks of Hull.

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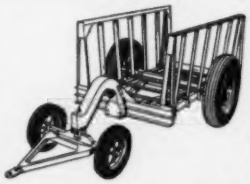
CUT COSTS WITH MARKHAM TRAILER TRAINS

A quicker and better job at far less cost!

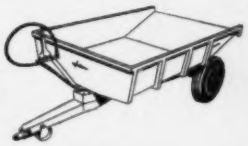
★ *They're not expensive*

★ *They're built for the job, and when it comes to rugged strength* **you can't beat the Markham specification!**

Markham's 5-Ton Heavy Pattern Sugar Cane Cart operates over the roughest terrain carrying large loads and is ideal for long journeys between plantation and factory. Large diam. rear wheels enable this cart to traverse uneven ground with ease. The swivel and pivot mounting of front axle ensure great stability making this Cane Cart extremely manoeuvrable.



For constructional jobs, road making, etc., this 3-ton hydraulic tipping 'Dumper' trailer is a winner; very strongly made, it will give years of service under the most arduous conditions.



For speedy, economical handling of cane, Markham's Cane Trailers are unsurpassed. They will work easily over rugged terrain, and their exceptional strength of construction ensures a long, trouble-free life.

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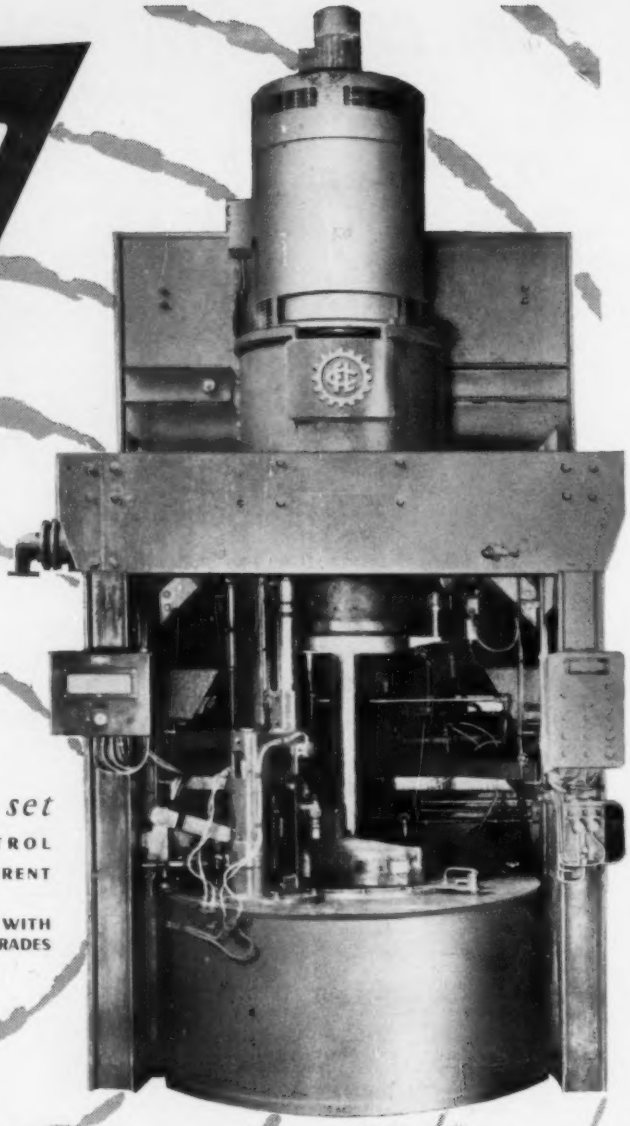

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- ELECTRONIC CONTROL
- ELIMINATION OF CURRENT PEAKS
- RECORD PRODUCTION WITH MASSECUITES OF ALL GRADES

Battery of 4 centrifugals at the Fontaine-le-Dun Sugar Factory (France)

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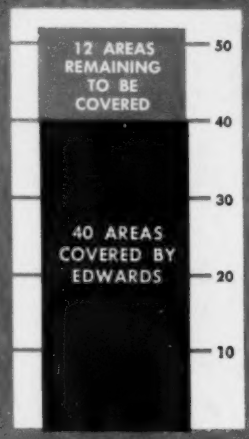
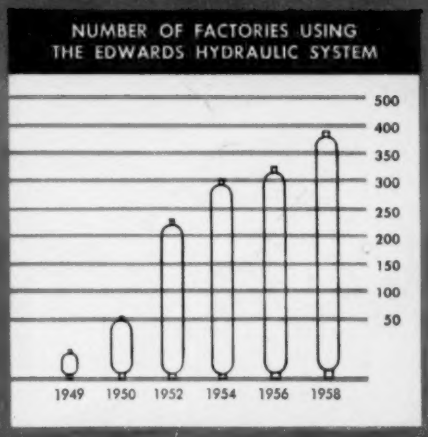
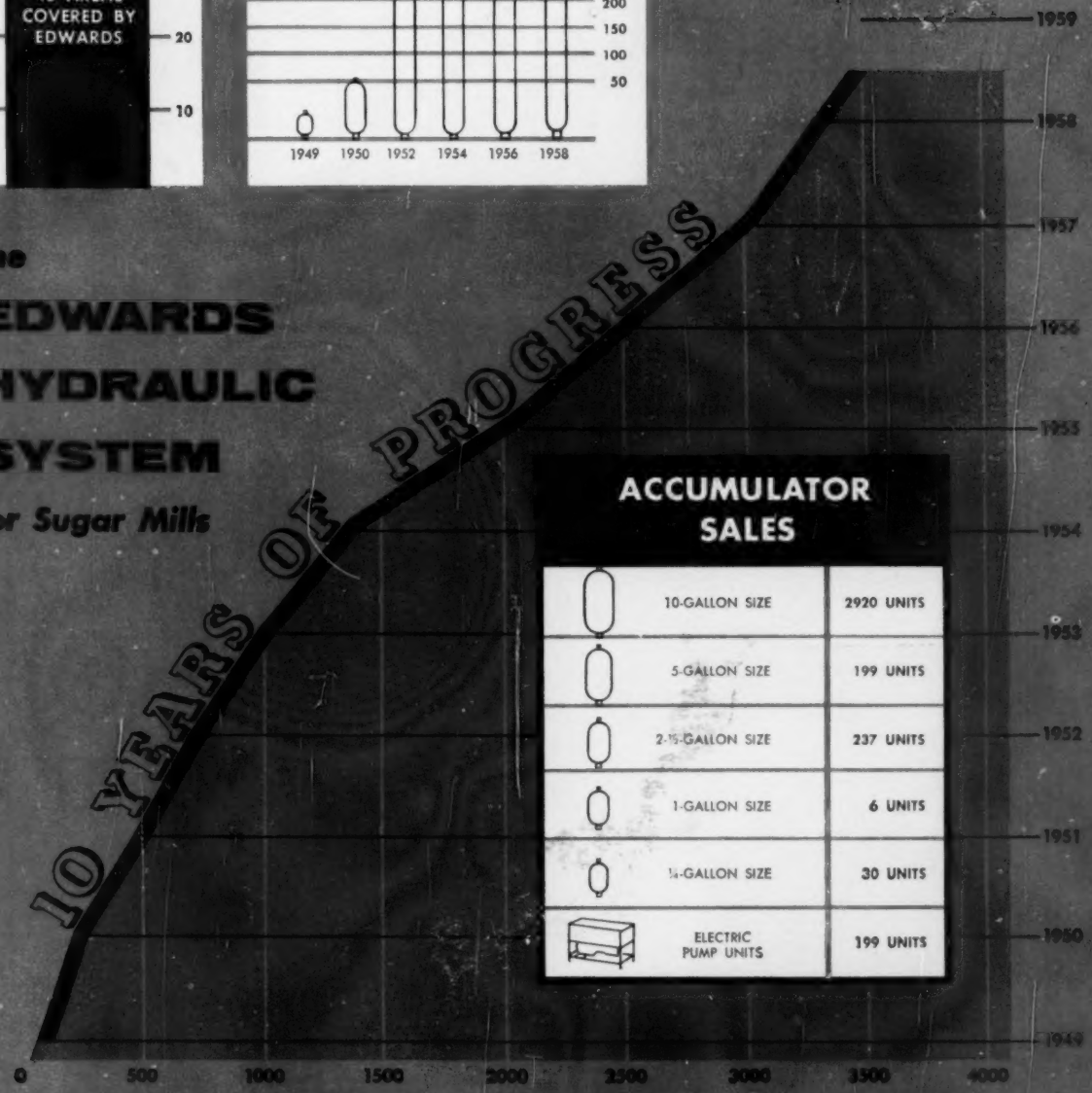




the EDWARDS HYDRAULIC SYSTEM *for Sugar Mills*



ACCUMULATOR SALES

10-GALLON SIZE	2920 UNITS
5-GALLON SIZE	199 UNITS
2½-GALLON SIZE	237 UNITS
1-GALLON SIZE	6 UNITS
½-GALLON SIZE	30 UNITS
ELECTRIC PUMP UNITS	199 UNITS

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*PATENTS
U. S. PATENT 2,691,339
British Patent 675,053
French Patent 1,020,664
Cuban Patent 15,078
Mexican Patent 52,402
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Safe foothold is assured in Tate & Lyle's Liverpool refinery by GRILL FLOOR flooring. Its open, non-slip surface sheds liquids, is easily cleaned and does not harbour dirt. On the stairways GRILL FLOOR stair treads and handrailing provide a sure footing

GRILL FLOOR stair treads at Tate & Lyle's Liverpool refinery.

Tate & Lyle's Liverpool refinery, flooring and handrailing by GRILL FLOORS

GRILL walkways

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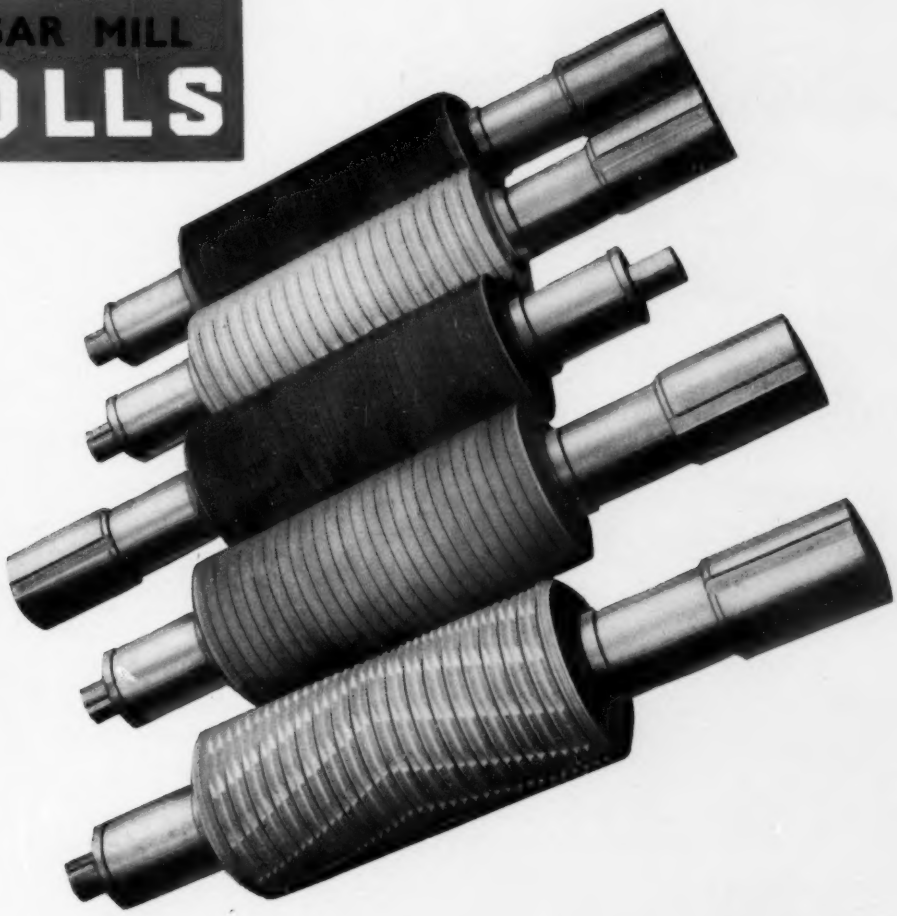
G.M. HAY SUGAR MILL ROLLS



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For Top Performance

G. M. HAY & CO. LTD. Ironfounders, GLASGOW

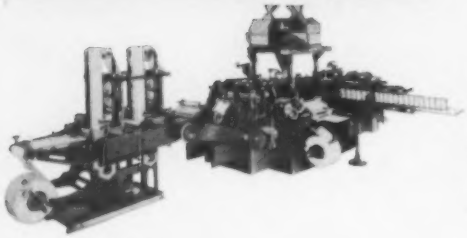
Sugar, being a basic consumer commodity, does not permit high packaging costs.

Therefore, cut packaging costs, to the minimum - pack automatically

HESSER

will show you the way.

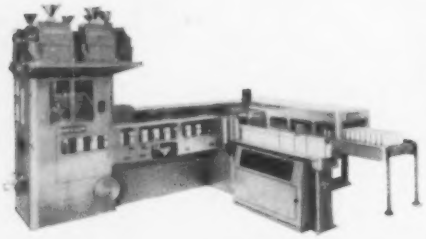
Output per 8 hour shift 2 persons in attendance, producing 2-lbs bags:



Machine Type PDHB(R)

equipped with 3 precision weighers makes up a lined bag, and fills and closes in one continuous operation. Up to three colour Aniline Printing attachment for printing the outer paper can be incorporated. This is the most economical way of manufacturing packages.

about **30** t



Machine Type PU IV

equipped with six automatic **precision weighers** feeding of length side seam glued skillets, opening, filling and closing, fully automatically.

Output about **50** t

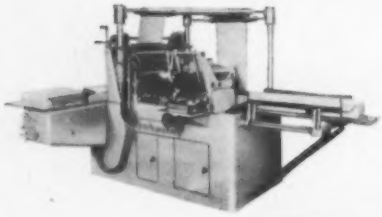
Machine Type PU IIIs

equipped with a **plate type volumetric filler** and working from the pre-glued skillets, which are opened, filled and closed, fully automatically.

Output about **100** t

Parcelling Machines

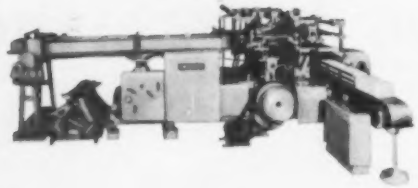
– can be supplied for direct coupling to packaging machines – thus contributing to lower packaging costs.



Parcelling Machine Type SP

wraps a pre – determined number of individual packages into Kraft paper, which can be printed on the machine.

Output up to **72** parcels per min.



Parcelling Machine Type WXO

is working on the same principle as described for the machine type SP. Due to its higher capacity, the machine will take the output of several packaging machines.

up to **30** parcels per min.

The parcels produced on these machines have a tight wrap and being firm and resistant, lend themselves ideally to piling when storing.

Representative in the United Kingdom: **JAHN (MASKINER) LTD., 34 York Way, Kings Cross London N.1**

FR.HESSER MASCHINENFABRIK AKTIENGESELLSCHAFT STUTTGART-BAD CANNSTATT, GEGR. 1861

Meet every cane carrying need with LINK-BELT

SS-600

CHAIN

Here's the chain that satisfies the demands of the most severe cane carrier service. In fact, with an average ultimate strength of 100,000 lbs., Link-Belt SS-600 chain is the strongest for its weight per foot of any cane carrier chain.

There's good reason for such remarkable capacity. Manufacture and assembly of this 6-inch pitch chain are closely controlled to provide the extra wear resistance necessary for long, trouble-free operation.

In addition to SS-600 chain, Link-Belt offers other 6-inch as well as 8-inch pitch carrier chains. Link-Belt can also furnish cane carrier slats in a broad range of types and sizes. For facts, call your Link-Belt representative or write for Book 2640 covering all Link-Belt sugar-handling equipment.

15,052

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LINK-BELT COMPANY: Engineers • Manufacturers • Exporters of Machinery for Handling Materials and Transmitting Power • Established 1875.

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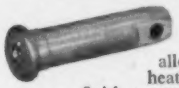
SIDEBARS are made of medium carbon alloy steel and are heat-treated to give maximum strength. Pin and bushing holes are accurately machined for correct pitch.



PINS of alloy steel are heat-treated and finish ground. They are positively locked against turning in the sidebars . . . are drilled for pressure lubrication.

COTTERS are furnished in brass as standard for greater corrosion resistance.

BUSHINGS are case-hardened and accurately made to close tolerances. The O.D. is finish ground for controlled press fit in the sidebars and to provide smooth, even bearing surfaces for the rollers.

ROLLERS are accurately machined and case-hardened to give long life. Bored smooth and true, they are finish ground on the O.D. to assure free rolling and minimum wear.

TUBES OF QUALITY

FOR THE SUGAR INDUSTRY

By courtesy of A. & W. Smith & Co. Ltd.

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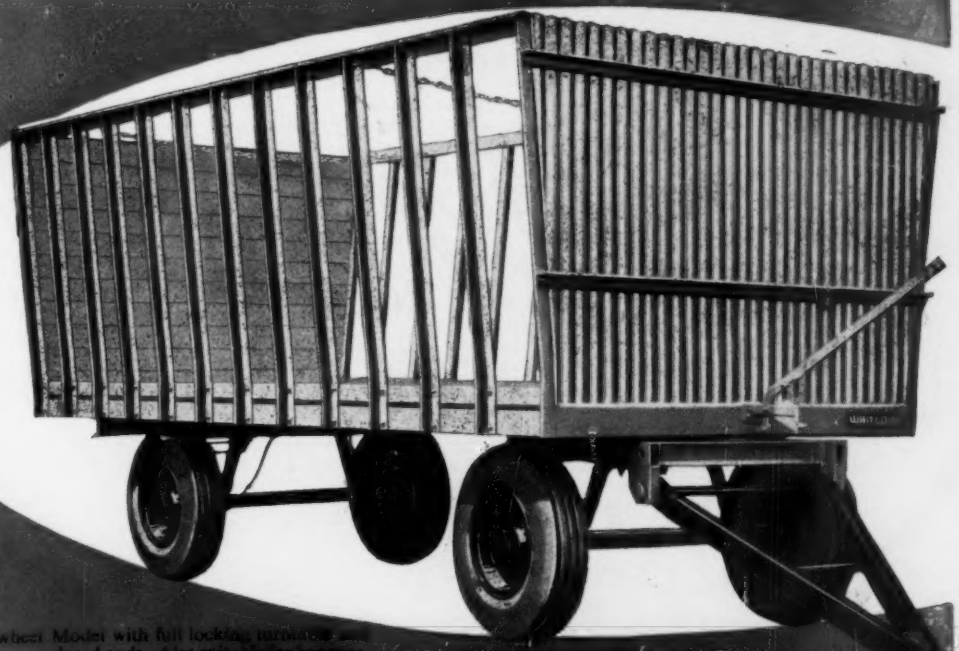
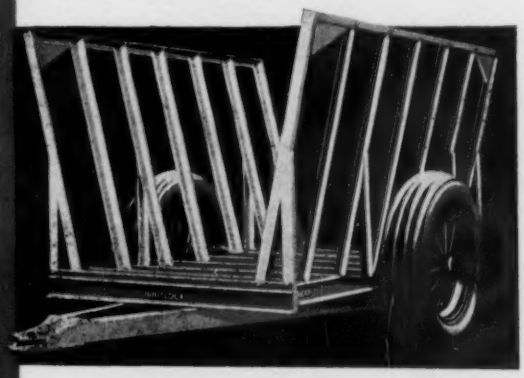


4-wheel Model with full locking turntable and open or closed ends. Also suitable for bananas, in various carrying capacities.

Cut cartage costs with

WHITLOCK CANE & FRUIT TRAILERS

4-wheel Goose-Neck type of pressed steel construction with extra heavy bracing for loads up to 6 tons.



A low cost model on large diameter wheels for loads up to 5 tons.

Our factory representatives are at the moment travelling the cane growing areas and may be visiting you personally.

Whitlock Cane Trailers are backed by many years experience and will stand-up to the job.

Ask for catalogue SC.41 and send details of your requirements.

WHITLOCK BROS LTD. GREAT YELDHAM ESSEX ENGLAND Tel: Great Yeldham 305 (8 lines)

Progressive Sugar Factories in –

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ARE INCREASING THEIR PRODUCTION BY USING

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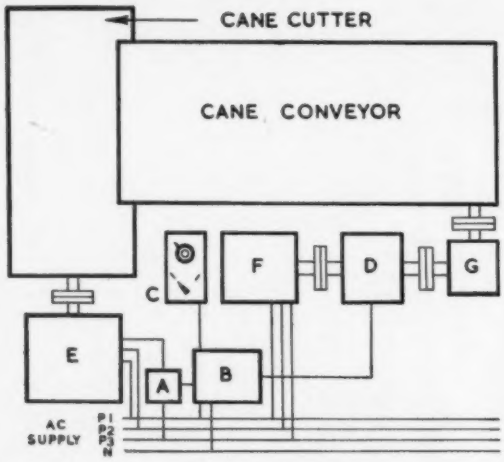
IN THE DRIVES TO CANE FEEDER CONVEYORS

Automatic regulation of feed ensures that cane knives are always working at peak efficiency thus achieving maximum throughput

Please send for details



KEY TO DIAGRAM

- **A** Current transformer
- **B** Electronic excitation unit
- **C** Manual control of conveyor speed
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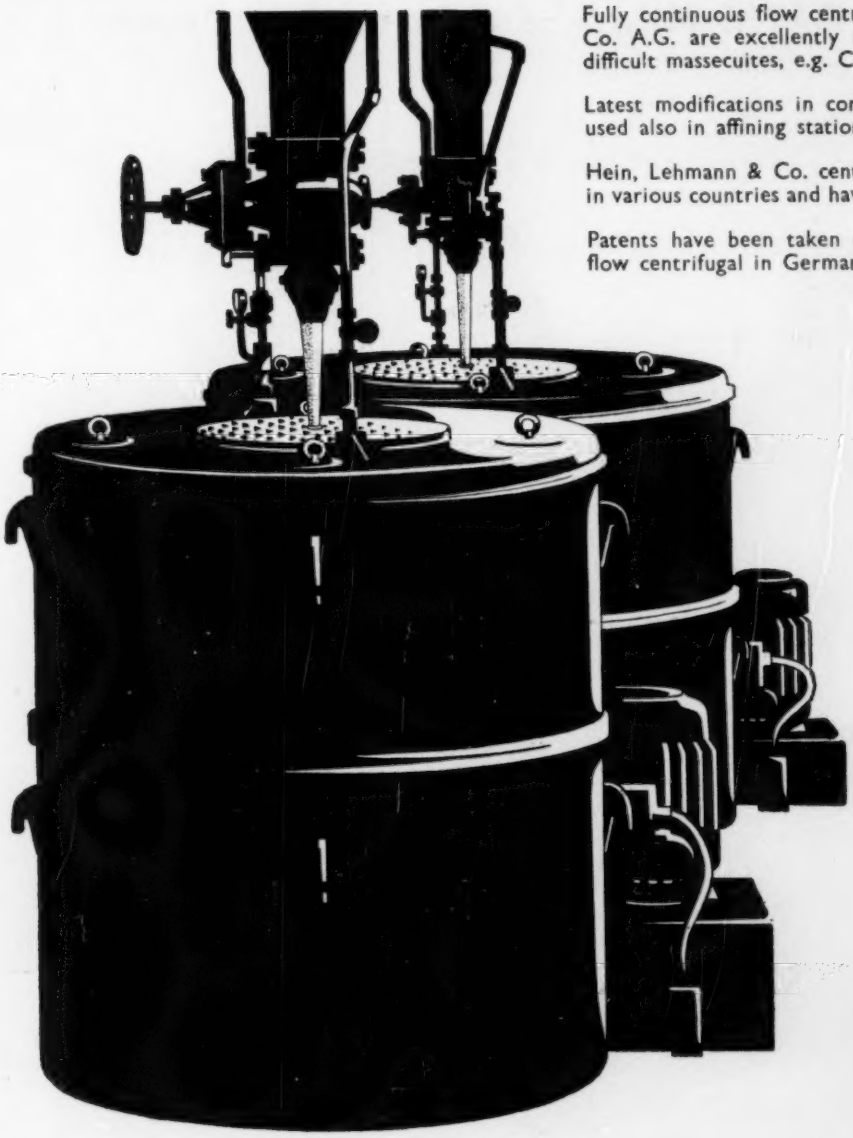

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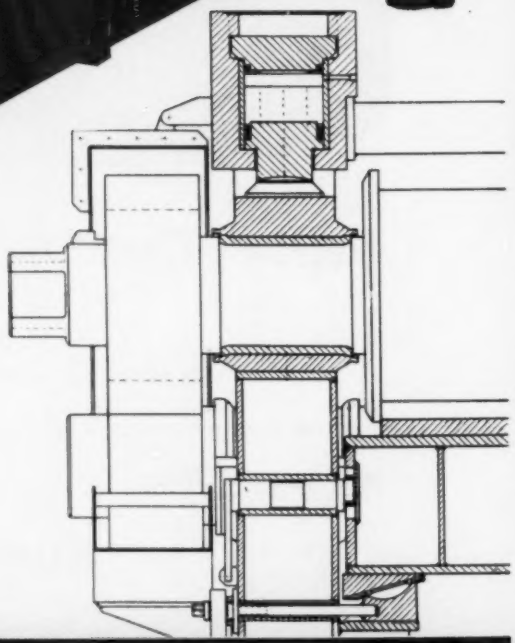

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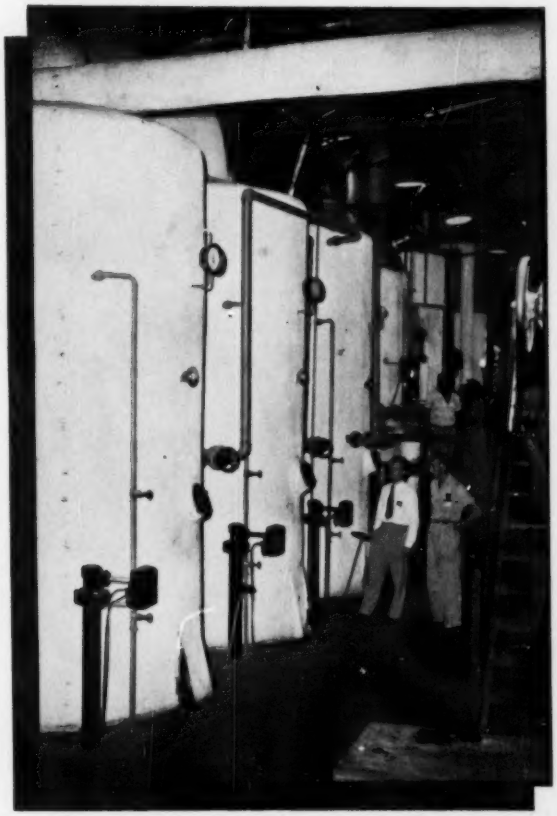

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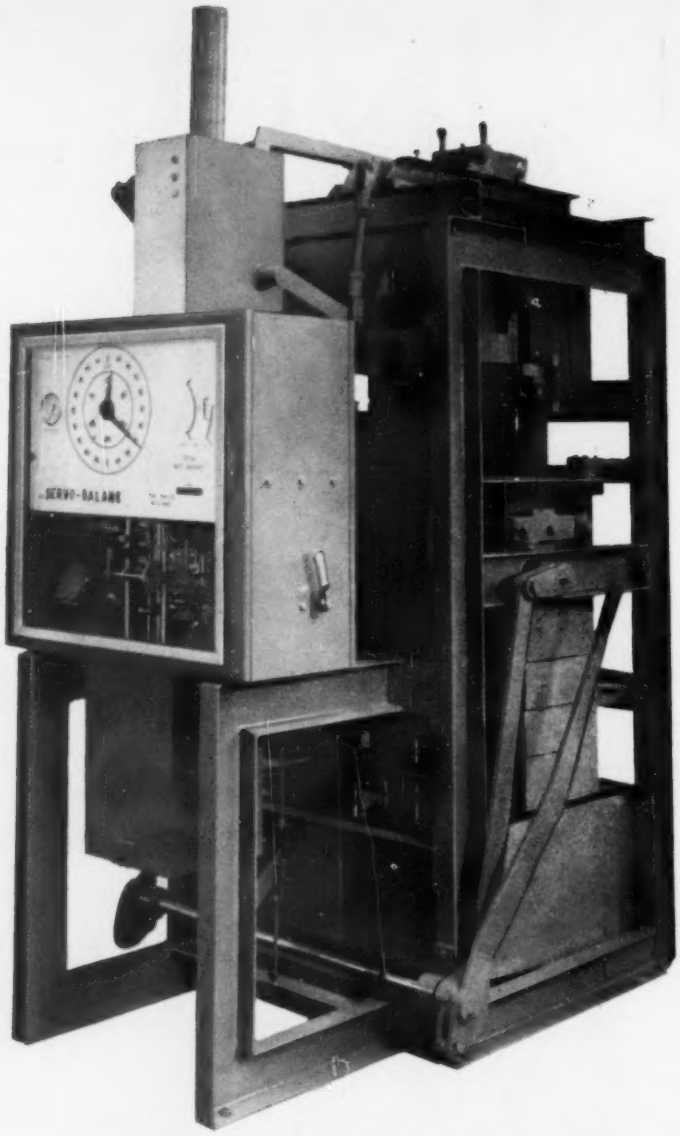

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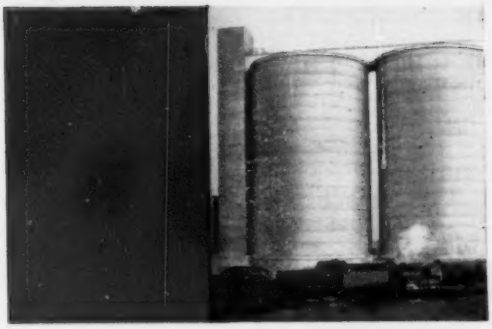

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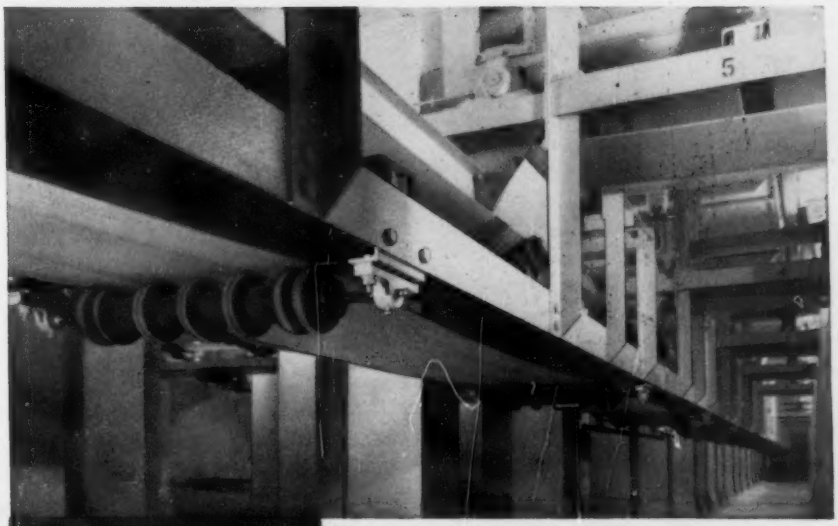

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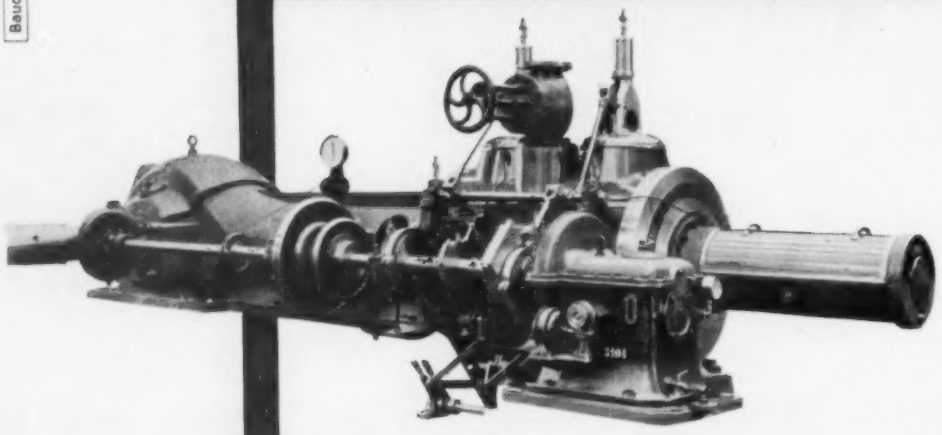

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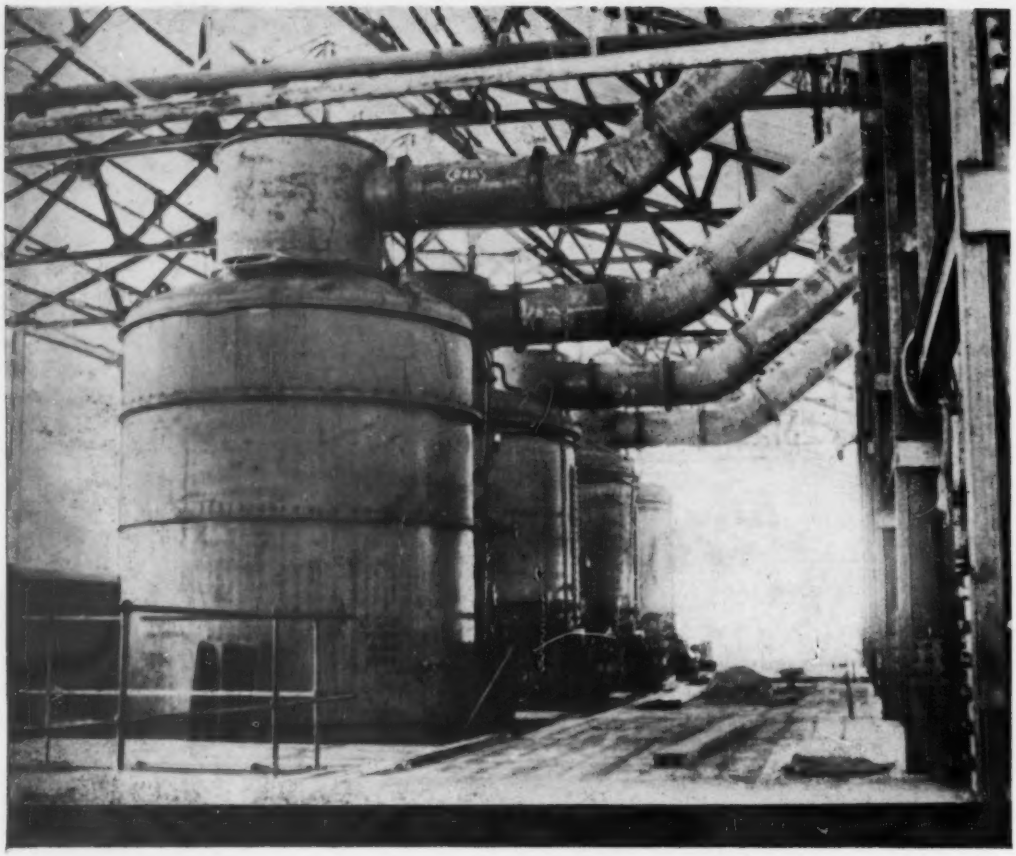

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International Sugar Journal

VOL. 61 *July 1959* No. 727

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Published by :
The International Sugar Journal Ltd.
7 & 8, Idol Lane, London, E.C.3.
Telephone : MANsion House 6822.
Cable : Sugaphilos, London.

Annual Subscription: 32s 0d or $5.00 post free
Single Copies: 2s 6d or 45 cents post free

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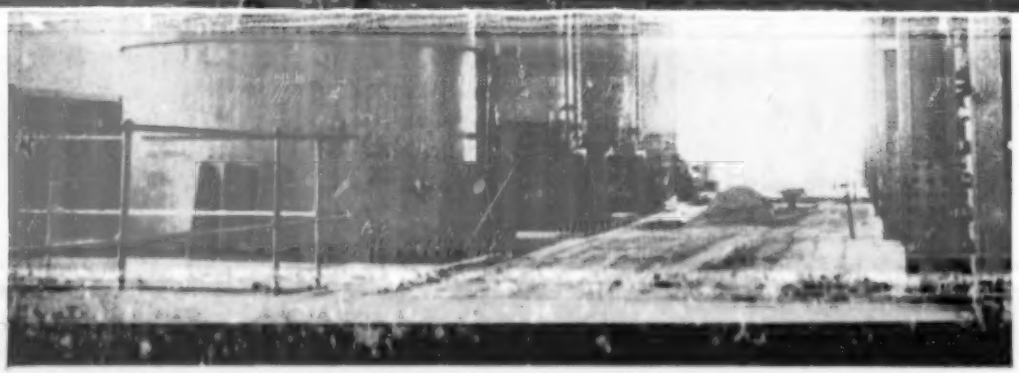

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THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXI JULY, 1959 No. 727

NOTES AND COMMENTS

Sugar Quotas Reduced[1].

The International Sugar Council unanimously decided on 17th June to cut quotas of participating exporting countries by the maximum provided for in the agreement, that is 20 per cent. of basic export tonnages of 50,000 tons or more and 10 per cent of those tonnages for other exporting countries.

This brief statement means that quotas now stand at 80 per cent. of basic tonnages for all member countries with quotas exceeding 50,000 tons and 90 per cent. for the smaller exporters. This compares with quotas of 92½ per cent. agreed at the February session of the council, and represents the maximum action under the terms of the agreement.

There is no mention of the 10 per cent. retention which was also introduced at the February session. It would appear that any extension of this retention would have to be voluntary and outside the terms of the agreement, as member countries are entitled to ship up to 80 per cent. of their basic quotas by September 1st.

In terms of sugar the cut in quotas represents around 1,300,00 metric tons of sugar off basic exports, or a reduction of 800,000 tons from the previous export quota level. If, however, there is no extension of the 10 per cent retention of exports, the latest cut in supplies available to the world's market from member countries is only 150,000 tons.

* * *

Cuban Agrarian Reform.

Early last month the new Agrarian Reform law was published in the Official Gazette, and the first meeting of the Agrarian Reform Institute set up as one of its provisions took place on the 4th June. The measures were first announced on the 19th May and fix the maximum permissible holding at 30 caballerías (1000 acres) with the exception of land used for rice, sugar, or cattle-raising where larger holdings will be allowed, subject to minimum yields per acre to be laid down by the Institute. Ownership of property is limited to Cubans or wholly-Cuban-owned companies although the Government has the power to grant land to foreign individuals or companies when the Institute considers this to be in the national interest. No shareholders in cane-growing companies will be permitted to hold shares in or run Cuban sugar mills.

Excess land is to be expropriated and divided among landless Cubans, while compensation to the former owners, based on the tax value of the land prior to 10th October 1958, will be payable in 20-year Government bonds bearing 4½% interest which interest is to be tax-free for 10 years, if invested in new Cuban industries. According to B. W. Dyer & Company, the New York sugar economists and brokers, these tax values are allegedly low and thus apparently enable the government to acquire land at prices below the real market value.

Two immediate results occurred : the value of shares of U.S. companies with Cuban sugar-producing interests (about 40% of Cuban sugar is produced with U.S. capital) dropped appreciably, and are lower than a month ago in spite of a statement in early June by the Cuban Premier, Dr. FIDEL CASTRO, that the expropriation of sugar lands would be postponed for a year. Secondly, development plans have been postponed until the long-term effects of the law have been clarified, new plantings have been suspended, etc.

C. Czarnikow Ltd. comment[2] : "Very grave doubts continue to be expressed as to Cuba's ability to maintain her production level if the large sugar estates are to be cut up into small holdings and farmed without experience. Suspension of new plantings must also ultimately have its effect on Cuba's future crop tonnages. Whilst the ratooning process (and the existence of stand-over cane) should assure an adequate output next season a substantial reduction would be looked for in 1961.

"These fears have not escaped the attention of the Cuban Government and, doubtless in an endeavour to restore confidence in the Island's ability, not only to maintain output, but even substantially to increase it, despite the reform measures, and to obtain a larger share of the U.S.A. domestic market, Dr. CASTRO offered to the U.S. Secretary of Agriculture 8,000,000 tons of sugar for 1961 at 4 cents per lb. This compares with a value on 10th June of about 5·40c f.a.s. Cuba."

The Cuban Premier also suggested that the lifting of restrictions on the U.S. domestic areas was unnecessary as Cuba could supply the entire needs of

[1] *The Times*, 18th June, 1959.
[2] *Sugar Review*, 1959, (409), 99.

the country! The offer was, of course, rejected because of the damaging effect it would have on the U.S. domestic sugar industries.

* * *

Sugar in the European Common Market[1].

The West German Sugar Association will send a proposal to the Common Market recommending a 3·25 per cent import tariff per English pound weight on sugar imported from countries outside the common market, according to industry sources in Bonn.

The proposal included recommendations to set up an Import Agency to stabilise domestic beet prices and protect the Common Market sugar industries from world price variations.

The Import Agency would operate a system giving preference to the sale of Common Market sugar thereby equating the price in the six countries.

The purpose of these recommendations is to guarantee preference of domestically-produced sugar and to safeguard supplies at steady prices according to demand.

Before the meeting of the Association last Wednesday, Herr LUECKER, a member of the Lower House and Germany's representative on the Agriculture Committee of the European Parliament, gave his views on the situation.

He said production in the six countries had risen from 2·3 million tons a year pre-war to 4·3 million a year in 1956/57. While the area on which beet was grown had increased to 995,000 hectares from 653,000 in the same periods respectively, productivity had risen to 31·8 tons per hectare from 28·9 tons.

Consumption of sugar and sugar-bearing products had risen to 24·9 kilos from 20·2 in these same periods respectively and the six members of the Common Market had an average annual export surplus of 150,000 tons between 1953 and 1956.

Herr LUECKNER made the following proposals for a common market policy: There should be a European Sugar Office to regulate imports and make provision for a steady market; this Office should start a sugar pool to make up for variations in production each year; there should be contracts between farmers and sugar-using factories; progressive levelling-off of taxes on the commodity in each member country to increase consumption; long-term supply agreements between Common Market members and a certain amount of sugar should be made available in the interim period before these proposals were adopted, at special conditions to the factories.

* * *

International Sugar Agreement Quota Deficits[2].

The quota deficits shown in the table have been declared under Article 11(1).

In the redistribution of these deficits the following countries have the priorities stated, under Section C(6) of Article 14: the first 50,000 tons to Cuba, the next 25,000 tons to Poland, the next 25,000 tons to Czechoslovakia (only 5000 tons have been accepted), and the next 10,000 tons to Hungary. The remainder, reallocated pro-rata, are indicated in the table[3].

Metric tons raw value	*Quotas in effect prior to reallocation*	*Renouncements*	*Reallocations Priorities Art.14(b)*	*Pro Rata distribution*	*Quotas in effect*
Belgium	50,875	—	—	1,642	52,517
Brazil	508,750	—	—	16,417	525,167
China (Taiwan)	689,415	—	—	19,551	708,966
Cuba	2,233,875	—	50,000	72,086	2,355,961
Czechoslovakia	254,375	—	25,000(ii)	—	259,375
Denmark	69,375	30,000	—	—	39,375
Dominican Republic ..	605,875	—	—	19,551	625,426
France	18,500	—	—	597	19,097
Haiti	41,625	—	—	1,343	42,968
Hungary	37,000	—	10,000	1,194	48,194
Indonesia	370,000	170,000(iii)	—	—	200,000
Italy	18,500	—	—	597	19,097
Mexico	69,375	—	—	2,239	71,614
Kingdom of the Netherlands	37,000	37,000	—	—	0
Peru	453,250	38,250	—	—	415,000
Philippines ..	40,360	—	—	746	41,106
Poland	198,776	—	25,000	6,567	230,343
Portugal	18,500	9,500	—	—	9,000
U.S.S.R.	168,986	—	—	5,970	174,956
(i)	5,884,412	284,750	110,000	148,500	5,838,162

(i) These quotas take account of charges for excesses in 1958 net exports.
(ii) Czechoslovakia: only 5,000 tons accepted.
(iii) Indonesia: includes special reserve of 46,250 tons which is not subject to reallocation.

Sugar Plans in Mainland China[4].—The sugar cane production target for 1959 is 20 million tons compared with 13·75 million tons in 1958. The planned beet production is 5·5 million tons compared with 2·9 million tons in 1958. A sugar production target of 2·2 million tons is aimed at by the end of the second five-year plan in 1962.

* * *

Plant Extension at Wallaceburg Factory[5].—Expansion of the Canada & Dominion Sugar Co. Ltd. factory at Wallaceburg, Ont., to 3000 tons capacity is under way, with installation of a new Foster Wheeler boiler of 100,000 lb/day capacity, three new pressure evaporator cells, a 3200-ton capacity D.d.S.-Silver beet diffuser, a dewatering screen, a belt weigher for cossettes, a new "Darco" press, new carbonatation equipment, etc.

* * *

It is regretted that this issue of the *International Sugar Journal* is published late as a result of a strike of printing workers in Great Britain. The publishers cannot tell how long the dispute is likely to last, but will try to produce the August 1959 and subsequent issues as best they can with the limited printing facilities available. We ask the indulgence of our readers and advertisers if we are not able to produce the *Journal* promptly. We will make up any delayed issues as soon as possible after the strike has been settled.

[1] *Public Ledger*, 6th June 1959.
[2] C. Czarnikow Ltd., *Sugar Review*, 1959, (406), 87–88; (407), 91.
[3] *I.S.C. Stat. Bull.*, 1959, **18**, (5), 75.
[4] *China Trades Economic Newsletter*, through C. Czarnikow Ltd. *Sugar Review*, 1959, (404), 81.
[5] *Up and Down the Rows*, 1959, (122), 2–4.

THE ARGENTINE SUGAR CROP OF 1958

By Dr. WILLIAM E. CROSS

THE sugar production of the Argentine in the year 1958 amounted to 1,014,103 metric tons, so that this country became one of the five or six most important cane sugar producing countries of the world. This was the largest crop ever produced in the history of the Argentine, and was enormously greater than those obtained in previous years[1].

The explanation of the record production of the year 1958 is to be found partly in the greater extension planted in cane in Tucumán and the Northern Provinces, but also, to a much more important degree, in the very favourable climatic conditions, especially with regard to the rainfall and the minimum winter temperatures. The rainfall in the greater part of the sugar areas was more than double the normal average; for instance in the city of Tucumán, which usually receives around 39 inches of rain between the beginning of September and the end of May, the total rainfall in this period was about 97 inches. And while in the winter, in most years, it freezes more or less severely in most of the cane zones—this was the chief cause of the low production of sugar, and the poor factory yields, experienced in Tucumán, Santa Fé and the Chaco in 1955 and 1957—in 1958 hardly any freezes of importance occurred in any of the cane areas. Under these favourable conditions the excellent varieties of cane now cultivated in this country, which are those we recommended and distributed, on the basis of the results obtained in our experimental work, in the years 1940–1954, had a rare chance to show their merits, and they responded nobly. The most important of these varieties are the Co 270, Co 290, Co 413, Co 421, CP 29/116, CP 34/120, POJ 2878, Tuc 1111, Tuc 1149, Tuc 2645, Tuc 2680, Tuc 2683, Tuc 3342, Tuc 4268, and Tuc 4441, though some others are also much cultivated in some zones. The large number of these varieties under cultivation is due to the fact that in this country cane is grown in many different zones, which differ greatly among themselves in their conditions of soils and climate, and for each of which certain varieties are preferred as specially suitable for those conditions. Unfortunately no census of the varieties planted in this country has been made since 1929, so that no statistics are available as to the extension occupied by each variety. In parenthesis we may observe that most of the varieties mentioned have been cultivated here during some twenty years, and up to now have shown no signs of "running out".

The length of the crop varied between 199 days and 98 days, and all the factories made almost exclusively white sugar and, with the exception of eight, a small proportion of raws. All the factories have chemical control, and prepare daily, fortnightly, and final reports on the basis of the data obtained ; but these results are not available for publication.

Regarding the production of molasses, of which the value has increased greatly in recent years, due to the very high prices prevailing for alcohol and forage, statistical data are available only for Tucumán. In Table I these data are given for the years 1955–1958.

TABLE I.

Production of molasses in Tucumán

Year	Tons of molasses produced	Molasses produced per cent cane
1955....	336,410	4.91
1956....	300,256	4.39
1957....	294,677	4.48
1958....	346,923	3.94

Estimating the production for 1958 in the remaining zones at approximately 115,000 tons, that for the whole country may be taken as around 462,000 tons.

Almost all the molasses produced was destined for the production of alcohol. This is done mainly in distilleries attached to the *ingenios*, of which seventeen of those in Tucumán, 3 in the Northern Provinces, one in Santa Fé, and one in the Chaco, are equipped in this way, although there have been established in recent years two or three independent distilleries, which purchase their molasses from the sugar factories. The manufacture of alcohol is started during the sugar crop, and continued during a good part of the year. Thus the alcohol production from the molasses of the 1958 crop will only be known in the middle of this year. But it can be estimated at around 120,000,000 litres. Most of the distilleries also produce a certain amount of fusel oil, which this year will probably reach around 150,000 litres. One *ingenio* also produces butanol, but no statistics as to the amounts manufactured are available.

Cane is cultivated by twenty-eight of the *ingenios*, and some twenty thousand independent growers. Of the former, some of the larger establishments have ten thousand hectares, or even more, under cultivation, and in the others the area varies all the way down to a thousand hectares or even less, those with a smaller area buying most of the cane they mill from the independent growers. This year, in Tucumán, around 79% of the total cane was bought cane, in the Northern Provinces some 19%, in Santa Fé approximately 98%, and in the Chaco some 6%. In the entire country, the bought cane milled amounted to around 66% of the whole. The areas cultivated by the independent growers vary from 2,000 hectares, or more in a few cases, down to ten or twenty hectares, these small planters being very numerous, representing much more than half of the total number.

Most of the cane is usually planted in rows, between the middle of April and the end of June. In Tucumán the rows are usually some six feet apart, but in the Northern Provinces five feet is more common. In the cultivation both animal and mechanical traction are used. Nitrogenous fertilizers only are employed, and that on less than half of the total cane area. Green manuring is hardly ever practised, and in

[1] See *I.S.J.*, 1959, **61**, 128.

most cases when the cane fields are replanted—usually after they reach five or six years stubble—this is done in the same fields. The harvesting is all done by hand, the cane being cleanly stripped, in a way which nowadays is unknown in many if not most other sugar countries.

From the fields near the factories the harvested cane is taken directly to the mill, but from the more distant fields it is taken to loading stations, where it is weighed and loaded on to trucks or railway cars, which take it to the factory. The chain-sling system of loading is almost universally employed. A small number of the *ingenios* have portable "decauville" railways.

The milling season begins about the middle of May, and continues usually until around the end of September, though some factories, especially in big production years, do not finish grinding until the end of October, or even until some time in November. In the very exceptional crop of 1958, nineteen factories in Tucumán did not finish until this latter month, and five continued in December. In all the crop period it rains very little, so that shut-downs from this cause are comparatively rare. The factories go on working continually right through the crop, not stopping for Sundays or holidays, and interrupting the milling only occasionally for cleaning—and of course, when necessary, because of mechanical break-downs.

THE 1957 SUGAR CANE EXPEDITION TO MELANESIA

THE expedition was sponsored by the United States Department of Agriculture in co-operation with the Hawaiian Sugar Planters' Association and the Queensland Bureau of Experiment Stations with the objective of augmenting the World Collection of Sugar Cane Germ Plasm. Considered of particular importance was a study of the various forms of *S. officinarum*, unknown as a wild form but of which there is no commercial and only garden cultivation in Melanesia. With the encroachment of civilization such forms may soon be lost. Less urgent, but as important, was a more detailed survey of the forms of wild *S. robustum* and *S. spontaneum*. Included in the survey collections were members of the *Andropogoneae* and other plants of possible economic interest. The considerable collections consisted of setts, which were sent to quarantine stations on Magnetic Island on the Great Barrier Reef and at Beltsville, Maryland. Fuzz was sent to Washington, D.C., and, in some cases, to Molokai, Hawaii.

An interesting account of the story of the expedition has recently been given by J. N. WARNER and C. O. GRASSL[1] and it gives in brief outline a history of earlier expeditions commencing with the visit of O. C. STONE in 1875 when he introduced 8 chewing varieties to Brisbane. Full advantage was taken of aerial transport to make a far more general survey than had previously been possible and the results particularly as regards distribution of recognized clones, are summed up under the different species, *S. officinarum*, *S. robustum*, *S. spontaneum* and *S. edule*. Certain of these clones have already been characterized both morphologically and cytologically from earlier material and, with the completion of the labour of a like study of the new material, our knowledge of the Genus should be considerably extended.

In spite of the wide ground covered by the expedition, there are other regions awaiting new, or more detailed surveys, and these are listed. Five Appendices list the collections of the species of *Saccharum*, both setts and seed, and a further Appendix those of the *Andropogoneae*.

H.M.-L.

Recent Attempts to Establish Borer Parasites in Louisiana. L. J. CHARPENTIER. *Sugar Bull.*, 1958, **37**, 64, 65.—The tachinids, Amazon fly (*Metagonistylum minense*) and the Cuban fly (*Lixophaga diatraeae*), have both shown themselves able to survive the Louisiana winter, but releases in the Houma area in 1955 and 1956 showed no parasitization by the former and only an average parasitization for the two years of 26% by the latter. Of other parasites of the borer, the wasp, *Agathis stigmaterus*, may have economic value.

* * *

A New Crop Rotation System. F. E. FARWELL. *Sugar Bull.*, 1959, **37**, 106, 107.—Two varieties of *Melilotus alba* var *annua* (Floranna) and the biennial form (Hubam) showed no recognizable difference and either proved a better rotational crop than any of the many alternatives tried.

* * *

Studies on the Nematode Fauna of Sugar Cane Fields in Mauritius. (1). The Genus *Mononchus*. J. R. WILLIAMS. *Mauritius Sugar Industry Research Inst., Occasional Paper*, 1958, (1), 13 pp.—14 species are described but the economic aspect is not touched on.

* * *

A Miscellany of Sugar Cane Diseases. C. G. HUGHES. *Tech. Comm. Bureau Sugar Expt. Sta.*, 1958, (1), 19 pp.—The word "disease" is here given a broad interpretation and the "diseases" described are at present ill-defined and under study at the Bureau's Pathology Farm.

[1] *Hawaiian Planters' Record*, 1958, **55**, 209–236.

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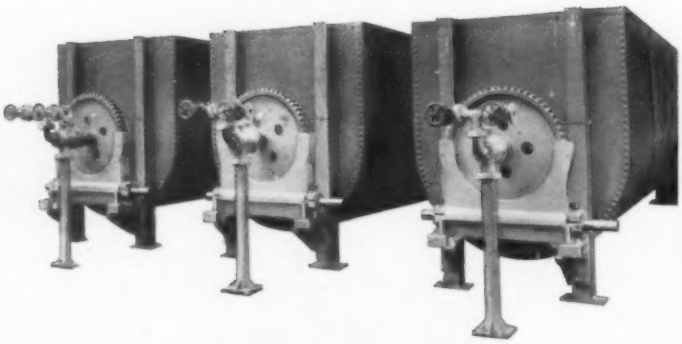

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SUGAR CANE AGRICULTURE IN MAURITIUS

MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE ANNUAL REPORT, 1957.

WEATHER conditions throughout the year were favourable except for local variations in rainfall distribution. Cyclonic disturbances were, fortunately, absent. The overall figures, whether for crop or acreage, of the different varieties have little meaning as a picture of the evolving varietal position owing to the wide variation in the different sectors of the island. Thus Ebène 1/37 is no longer planted in the North sector yet supplied 65% of the cane crushed in the Central sector. A better indication is given by the area planted ; between 1954 and 1957 the figure for M 134/32 has fallen from some 55% to 8%, those for Ebène 1/37 and B varieties have remained approximately constant and those for the grouped M varieties 147/44, 31/45 and 112/34 have risen from some 2% to 45%. The same is true for commercial yields which, however, exceeded the 1947-57 average: tons cane per arpent, 25·6 (24·9); commercial sugar % cane, 12·93 (12·33); tons sugar per arpent, 3·31 (3·07) ; and a total production of 561,600 tons raw sugar at 98·5 polarization.

Cane Breeding

Climatic conditions did not favour arrowing, yet all but a few of the crossings desired were effected. 429 selections were made from 1st ratoons of the M/55 series and 44 varieties retained from 2nd ratoons for multiplication and trial on estates. A selection from the M/53 series appeared, from its morphological appearance, to be an intergeneric cross between cane and either maize or sorghum.

Harvested trials on estates number 44. Of the two most promising varieties, M 147/44 is remarkably adapted to the warm, irrigated areas of the West ; it is probably early-maturing. Of the other, M 31/45, the value is less clear. It is a mid-season variety which, under humid conditions, appears superior to M 134/32, especially in yield sugar/acre, but hardly matches Ebène 1/37 under super-humid conditions. Brief notes are given of Ebène 1/44 and other promising varieties of later M series. The relative adaptability of these varieties and of certain others of more recent origin to different regions, as determined by estate trials, is given in a separate note.

A study aimed at determining the efficiency of sampling methods, compares stool *vs.* random sampling of 10 stalks and also the relative values of top, middle and bottom samples. In the former case, no significant differences were found in mean Brix, fibre and c.c.s. ; the latter suggests a sample composed of 40–50 middles. The experiment is to be continued and expanded to include determination of the number of canes required to represent a plot.

Nutrition and Soils

The study of the composition of cane juice, two earlier accounts of which appeared in the two previous Annual Reports of the Institute and dealt respectively with "The Amino acid and Nitrogen Content of the Juice" and with "The Influence of Variety and other Factors on the Level of some Ash Constituents of the Juice", is here continued to cover the organic acid constituents. The aconitic acid content, as determined by chromatographic methods, of typical samples of local juice is less than one quarter of that found in Louisiana juice.

In connexion with chemical fertilization, discussion centres on correlations between total sugar production and imports of the three major elements, N, P and K, considered in terms of 5-year averages. There is seen a close relationship between sugar production and imports of N as well as of K, the latter, however, at a lower level. In contrast, imports of P since 1945 show a gradual, if slight falling off, though foliar studies indicate that more than one third of the cane lands are deficient in P. The P position at the moment dominates the fertilizer problem and the question of substitution of "guano phosphate" by some form of soluble phosphate is now under study.

Improvements in the technique of foliar diagnosis are reported and the results compared with stalk analysis. The major difference lies in the stability of the leaf P_2O_5 even when the stem P_2O_5 shows a conspicuous drop. It would seem that the leaf level is maintained at the expense of the stem and no injury is done until the leaf P_2O_5 is affected.

Cane Diseases

Chlorotic Streak.—In dry areas canes infected with this disease characteristic of super-humid regions show a gradual recovery, with freedom in the ratoon crop. Under super-humid conditions, apparently disease-free cuttings, even after hot water treatment, show a steady increase of infection after 3–5 months. Transmission studies so far have shown no clear indication of the method of infection, whether through the soil, parasitic phanerogams or intertwined root systems.

Ratoon Stunting Disease.—Severity of the disease appears to be increased by unfavourable conditions, whether of drought or excessive moisture. A hot water treatment plant to handle 6500 tons annually—enough to supply nurseries giving sufficient planting material in the following year for all estates and large planters—is being installed. From it, the treated setts will pass to a fungicide tank, thus assisting in rapid cooling. A similar scheme is being implemented for small farmers. A technique for testing for the disease, using 2,3,5-triphenyl tetrazolium chloride as a colour indicator, is described.

Some degree of control was obtained over pineapple disease by 5 mercurial and one tin organic fungicides.

Cane Pests

Both "Chlordane" and "Aldrin" are shown to be highly effective in controlling *Clemora smithi* when applied in emulsion form along the furrows at planting. In the economic aspect, the latter is more effective weight-for-weight and cheaper than the latter but has yet to be proved as durable as "Chlordane", which retains its toxicity after several years in the soil.

In view of the risk of importation of Fiji disease from Madagascar by air, attempts have been made to introduce *Tytthus mundulus* from Hawaii as a control of *Perkinsellia saccharicida*, a known vector of the disease. In only one case does the Mirid appear to have established itself and success seems to depend on the release of adequate numbers.

Weed Control

Trials with CMU (2–10 lb/arp) and DCMU (4–8 lb/arp) showed varying reductions of infestation, the latter being in general more effective, and, in both, split applications (2 months' interval) gave the better kill. The drought, however, may have affected the results. Brief notes on new herbicides and on the control of specific weeds are added.

Cultivation and Ecology

An interesting, if brief, account is given of the reclamation of the Plaine des Roches, an area of some 11,500 arpents of marginal land covered by recent and only partially weathered lava. Heavy equipment is used to clear slabs and stones. Under a rainfall of 60 inches per annum, preliminary yields of 26 tons/arpent appear to justify extension of the reclamation work.

A final section of the Report uses regression equations to determine the relationship, both in excess and deficit, between the rainfall of the different regions and the cane and sugar yields, and to assess the return from irrigation.

H. M. L.

AGRICULTURAL ABSTRACTS

Effect of Gibberellic Acid on the Growth of Sugar Cane. R. E. COLEMAN. *Sugar J.* (La.), 1958, **20,** (11), 23–27.—The literature is reviewed and experimental results are again recorded.[1]

* * *

Degeneration of the Sugar Cane. F. MARTIN. *Ind. Alim. Agric.*, 1958, **75,** 551–558.—The diseases associated with degeneration discussed here are sereh, mosaic and Fiji disease; for the present, ratoon stunting disease is not included. The nature and symptoms of these diseases are set forth and the major remedy through hybridization is discussed at some length. Other features of cane cultivation are considered with emphasis on the nature of the sett used in replanting, whether from the top and immature, or from the bottom and mature stalk tissues. It is suggested that degeneration may be a function of maturity of planting material and it is believed that it is the immature tissues that show the phenomenon; this suggestion should be tested by continued replanting under uniform conditions of setts taken respectively from the top and bottom of the stalk.

* * *

Soil Fertility Studies. Organic Matter and Humus Decomposition. H. F. BURCH and M. T. FRIEND. *E. Afr. Agric. For. Res. Org. Rpt.*, 1956, 18–22; through *Soils and Fertilizers*, 1958, **21,** 1630.—In the presence of clay in soil, considerable amounts of recently decomposed organic material are retained and protected against microbial attack occurring under moist conditions. This protected material is liberated by drying and is rapidly decomposed when microbial activity begins on rewetting. The organic fraction interacting with the clay fraction is generally of a low C/N ratio. Under conditions of alternate wet and dry seasons, organic material liberated during the dry period will rapidly decompose at the start of rains, while organic matter resulting from the breakdown of leaf litter will replace the organic fraction lost during decomposition. These observations explain the beneficial effects of burning (release of decomposable material), the NO_3 flush (large amounts of soil NO_3 at the start of rains) and the beneficial effects of additions of fresh organic matter to soils. [This may be compared with the observations of G. CLARKE[2] in the Gangetic plains, showing nitrate accumulation during the hot, dry season preceding the rains and with the abiotic nitrogen fixation described by N. R. DHAR.][3]

* * *

Contributions to the Cytology of the Genus Saccharum. VI. Chromosome Number of Saccharum spontaneum in Japan Islands. A. MORIYA. *Cytologia, Tokyo*, 1956, **21,** 188–191; through *Plant Breeding Abstracts*, 1958, **28,** 4491.—Clones of *S. spontaneum* collected in Japan proper have $2n = 112$. In a clone from Amami Oshima Island, the chromosome number was $2n = 104$ while a clone from Okiawa Island had $2n = 112$. The author's hypothesis that Japanese and Formosan varieties of *S. spontaneum* may have an independent distribution from Java is confirmed by a comparison of morphological characters.

* * *

Ratoon Stunting Disease and its Control. E. V. ABBOTT. *Bol. Ofic. A.T.A.C.*, 1958, **17,** 457–466.—The history, symptoms (both external and internal), methods of transmission, influence on yield of the disease and the means of control by knife sterilization, hot water or air and varietal resistance are briefly described.

[1] *Cf. I.S.J.*, 1959, **61,** 69.
[2] *I.S.J.*, 1948, **50,** 202.
[3] *I.S.J.* 1958, **60,** 317.

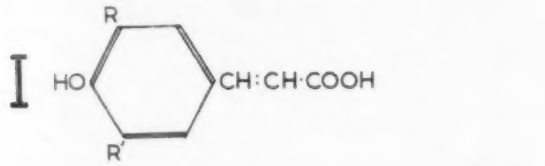
THE PHENOLIC CONSTITUENTS OF SUGAR CANE

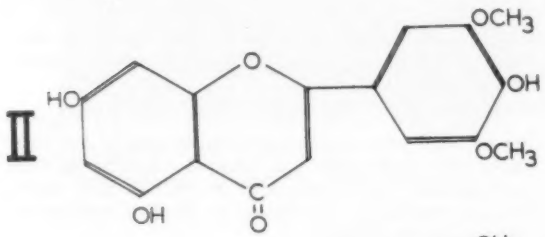
By ROGER STEVENS*

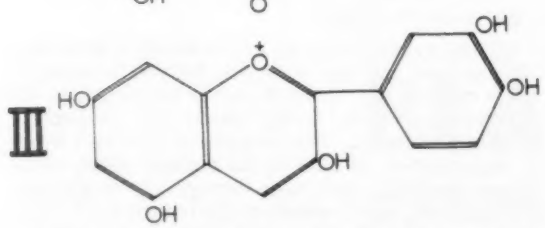
(Dept. of Sugar Chemistry and Technology, The Imperial College of Tropical Agriculture, Trinidad, W.I.)

THE constituents of the sugar cane (*Saccharum officinarum L.*) have recently been the subject of two excellent reviews[1,2] in which the occurrence of phenolic materials such as lignin, tannins, and anthocyanins is recorded. There are, however, few references in the literature of the sugar cane to the characterisation of simpler phenolic compounds. Those which should be mentioned are to the occurrence of syringic acid in cane juice[3], phloroglucinol in potassium-deficient cane[4], and material in the root of *S. officinarum* which gives a positive reaction for leucoanthocyanins[5].

In this note the results of an investigation of the phenolic constituents of the sugar cane, by means of paper chromatography, are reported. The techniques used were chiefly those developed by BATE SMITH[6,7,8] and SWAIN[9]. Briefly, the material under examination was hydrolysed with 2*N* hydrochloric acid and the phenolic aglycones were extracted into a layer of amyl alcohol. Aliquots of the amyl alcohol layer were then used for paper chromatography. The solvent systems used were "Forestal" and toluene : acetic acid : water (4 : 1 : 5)[6]. When sugar cane juice was examined by this method no simple phenolic constituents could be identified, but a sample of filter mud from a commercial factory was shown to contain ferulic acid (I; $R=OCH_3$, $R'=H$).







Examination of leaf material (from the variety B 37–172) led to the identification of *p*-coumaric acid (I; $R=R'=H$), ferulic, and sinapic (I; $R=R'=OCH_3$) acids, of which ferulic acid was judged to be the most abundant. The presence of caffeic acid (I; $R=OH$, $R'=H$) was also suggested by several chromatograms but the immobility of this acid in the toluene : acetic acid solvent made it difficult to confirm this identification. BATE SMITH[8] has divided plants, on the basis of their phenolic constituents, into ten classes. From this work sugar cane will fit into either class H or I of BATE SMITH's scheme (plants in class H have caffeic acid, which is absent from class I). 36% (the largest single group) of the monocotyledons examined by BATE SMITH were in these two classes. He further states "The Gramineae consistently have ferulic acid, occasionally sinapic acid, and consistently the unusual flavone, tricin".(II) In this investigation tricin was not detected in the leaves of sugar cane on any occasion, but a substance, which behaved in the manner reported for tricin, was found in several other tropical grasses (see Table I).

Table I.

Occurence of Tricin and Ferulic Acid in Tropical Grasses.
(Chromatograms were run in 'Forestal')

Species	*Tricin* ($R_f = 0{\cdot}78$)	*Ferulic Acid* ($R_f = 0{\cdot}88$)
Axonopus compressus—Savanna grass	+	+
Cynodon dactylon—Devil's grass	—	+
Tripsacum laxum—Guatemala grass	+	+
Pennisetum purpureum—Elephant grass	++	+
Guadua angustifolia—Bamboo	++	+
Bambusa vulgaris—Bamboo	++	+
Saccharum officinarum—Sugar cane	—	+

The cane of variety B 37–161 has a bright pigment beneath the cuticle, the aglycone of which was found to behave as cyanidin (III) on paper chromatograms. In connection with this observation it should be recalled that DASA RAO, WALAWALKAR and SRIKANTAN[10] have isolated an anthocyanin, as its crystalline hydrochloride, $C_{28}H_{33}O_{17}Cl \cdot 4H_2O$, from the rind of "Purple Mauritius" cane. The aglycone of this pigment was thought to be a mono-O-methyldelphinidin, but such compounds are of very limited occurrence whereas cyanidin is the most widely distributed anthocyanidin.

ACKNOWLEDGMENTS.

This paper forms part of the programme of the B.W.I. Sugar Research Scheme. I should like to thank Mr. N. W. SIMMONDS for many helpful discussions and for identifying botanical material.

* Present address : The Brewing Industry Research Foundation, Nutfield, Surrey.

1 BINKLEY and WOLFROM : *Adv. Carbohydrate Chem.*, 1953, **8**, 291.
2 BURR *et al.*: *Ann. Rev. Plant Physiol.*, 1957, **8**, 275.
3 ROBERTS and MARTIN : *Anal. Chem.*, 1954, **26**, 815.
4 HARTT : *Plant Physiol.*, 1934, **9**, 399.
5 BATE SMITH and LERNER : *Biochem. J.*, 1954, **58**, 126.
6 *Biochem. J.*, 1954, **58**, 122.
7 *Chem. and Ind.*, 1954, 1457.
8 *Sci. Proc. R. Dublin Soc.*, 1956, **27**, 165.
9 *Biochem. J.*, 1953, **53**, 200.
10 *J. Indian Chem. Soc.*, 1938, **15**, 27.

A COMPARATIVE STUDY ON REMELTING OF SUGAR WITH WATER AND JUICE

By B. L. MITTAL

S. P. SANYAL[1] has calculated and discussed the steam consumption in remelting of sugar with water and clear juice. He concludes that :—

(i) extra steam consumption in the case of melting sugar with water is only 0·39% cane, and

(ii) for a saving of only 0·39% of steam on cane it is not desirable to melt the sugar in clear juice, mainly because

(a) the entire pipeline conveying the clear juice is found always full of deteriorated juice, especially when the pipeline is a long one and the melting stops for any reason and

(b) when the melt is mixed with the bulk of clear juice and sent to the evaporators, there is bound to be some unknown loss, because the melt is always acidic and the boiling temperature in the first body of a quadruple is quite high.

The writer fails to agree with the views expressed above for the reasons explained below :—

(1) Let us suppose that clear juice is of 15° Bx and 85 purity, final molasses is of 100° Bx and 33 purity, purity of final massecuite is 60, and purity of double-cured final sugar is 99. Then calculating on the basis of 100 tons of cane, with clear juice % cane as 100, non sugar in clear juice = 15—15 × ·85 = 2·25 tons. and non sugar % final molasses = 100—33 = 67. Hence 2·25 tons non sugars will produce $= 2{\cdot}25 \times \frac{100}{67} = 3{\cdot}36$ tons molasses. Let X be the molasses percent final massecuite, then, $60 = X \times \frac{33}{100} + (100-X) \times \frac{99}{100}$ or $X = 59{\cdot}1$. Hence quantity of final massecuite produced $= \frac{100 \times 3{\cdot}36}{59{\cdot}1} =$ 5·69 tons. The quantity of final sugar = 5·69–3·36 = 2·33 tons. 2·33 tons sugar of 99 purity has to be melted with 15°Bx and 85 purity clear juice to a 60°Bx syrup. Let Y be the quantity of clear juice required for the purpose, then equating for sugar, $(2{\cdot}33 + Y \times 0{\cdot}15 \times 0{\cdot}85) \times \frac{100}{60} = 2{\cdot}33 + Y$. Hence, $Y =$ 1·97 tons. Therefore total sugar in melt = 2·33 × 0·99 + 1·97 × 0·15 × 0·85 = 2·56 tons, and total Brix in melt = 2·33 + 1·97 × 15 = 2·63 tons, so purity of melt $= \frac{2{\cdot}56}{2{\cdot}63} \times 100 = 97{\cdot}34$.

If the sugar were melted with water, the purity of the melt would be 99·00 i.e. the purity of the sugar itself. It is a matter of common knowledge that lower purity of melt is an advantage in adjusting the boiling scheme.

(2) Besides the economy of 0·39% steam, there is further economy of 0·19% steam in melting sugar with clear juice. Sugar has to be melted in hot liquid either clear juice or water. Clear juice is already hot when it is drawn directly from the overflow box of a clarifier, and there is no necessity of reheating it in the melters while in case of water, it has to be heated to a desirable temperature (say 195°F) for quick and efficient melting. Steam thus required is calculated as follows :

Water required for melting 2·33 tons sugar $= 2{\cdot}33 \left(\frac{100}{60} - 1\right) = 1{\cdot}55$ tons.

If we suppose the initial temperature of the water is 75°F, then the sensible heat required to heat 1 lb of water to 195° F = 195–75 = 120 B.Th.U. Hence heat required to heat 1·55 tons of water = 1·55 × 2240 × 120 = 416,640 B.Th.U.

If the average heat supplied by 1 lb of steam be 1000 B.Th.U. then steam required is

$\frac{416640}{1000} = 416{\cdot}6$ lb

$= 0{\cdot}19\%$ cane.

Hence total extra steam consumption in case of melting sugar with water is 0·39 + 0·19 = 0·58% cane. The calculations for steam consumption are purely theoretical and in practice this extra consumption of steam is never less than 1% cane, which is by no means an insignificant amount.

(3) As calculated above, 1·97 tons of clear juice is required for melting 2·33 tons of sugar, so that by using clear juice as a remelting medium the load on the multiple effect is reduced by 1·97% without effecting the capacity of pan station at all. This is very significant where milling capacities have been expanded with comparatively low capacities of multiple effect evaporators.

(4) The pipes can be and are fitted in such a way that the residual juice in the pipe line returns to the clear juices tank or elsewhere as desired, whereby the pipe lines remain clean and free of deteriorated juice. This is, therefore, no reason to discard melting of sugar with clear juice.

(5) In rare cases only, the melt is mixed with the bulk of clear juice and sent to the first body of the multiple effect evaporator. The melt should be pumped to the pan-station supply tanks, preferably through a sulphitation tower. Thus instead of increased losses in recirculation of melt in the multiple effect, circulation of 1·97% clear juice through the evaporator is eliminated, which results in the reduction of losses taking place by inversion, carbonization and entrainment etc. and consequently the total colour formation in the evaporation process is also lower.

[1] *I.S.J.*, 1959, **61**, 80–81.

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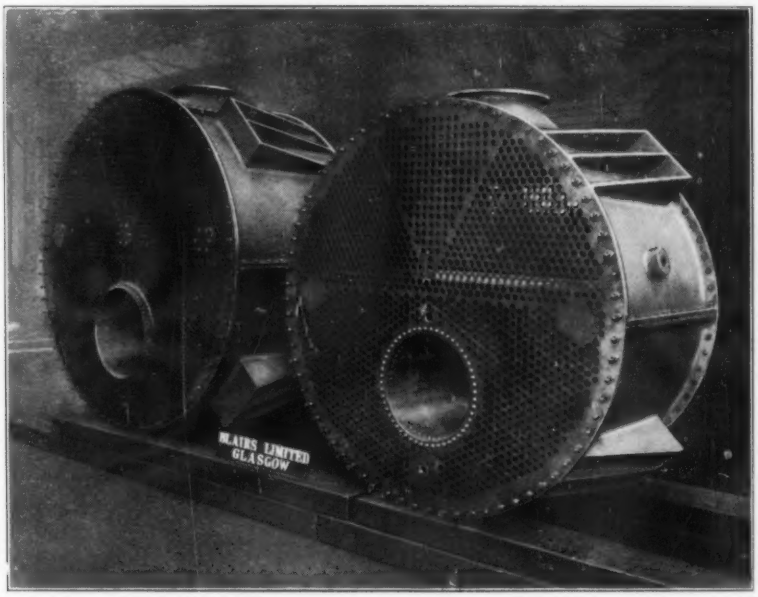

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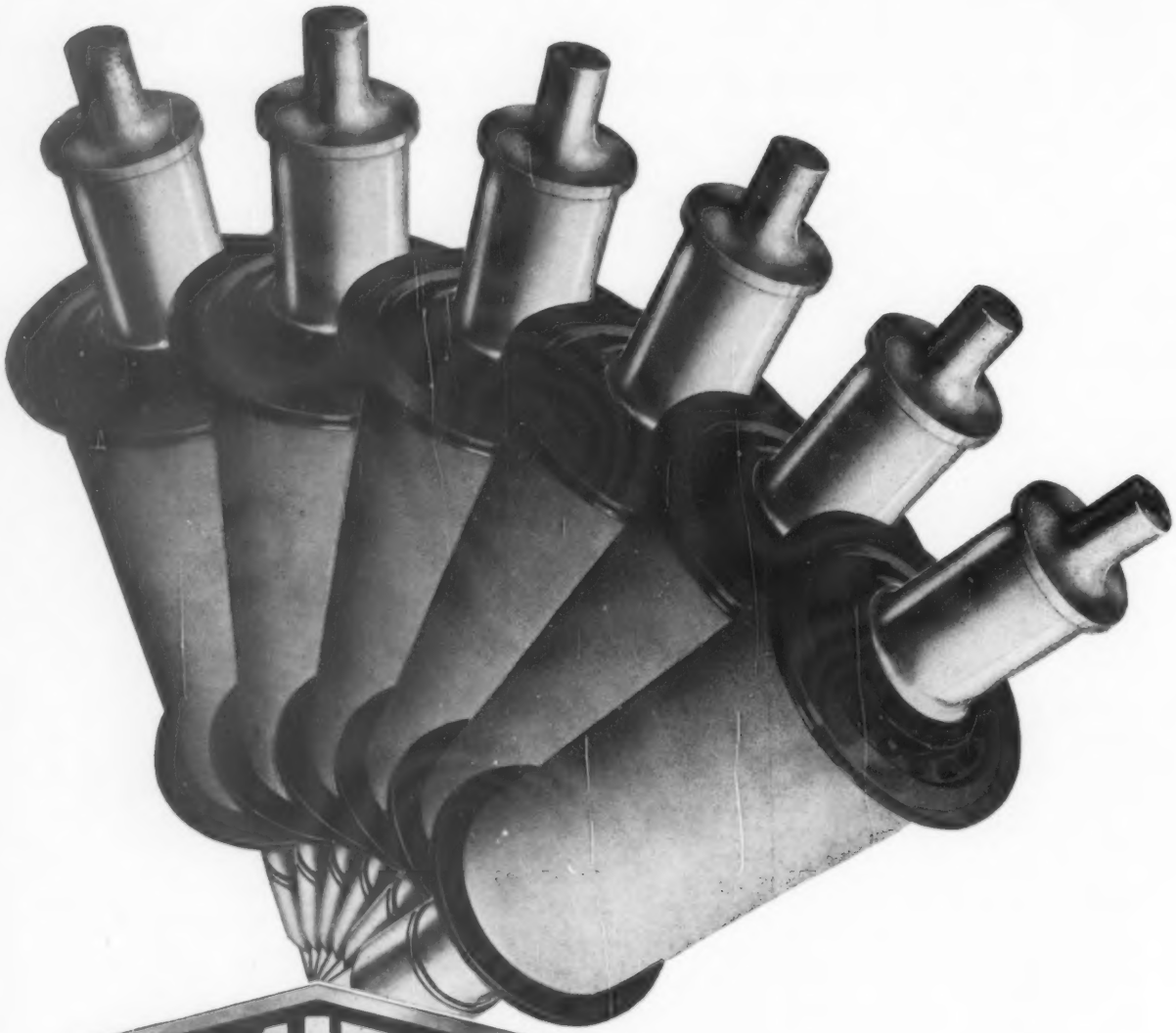

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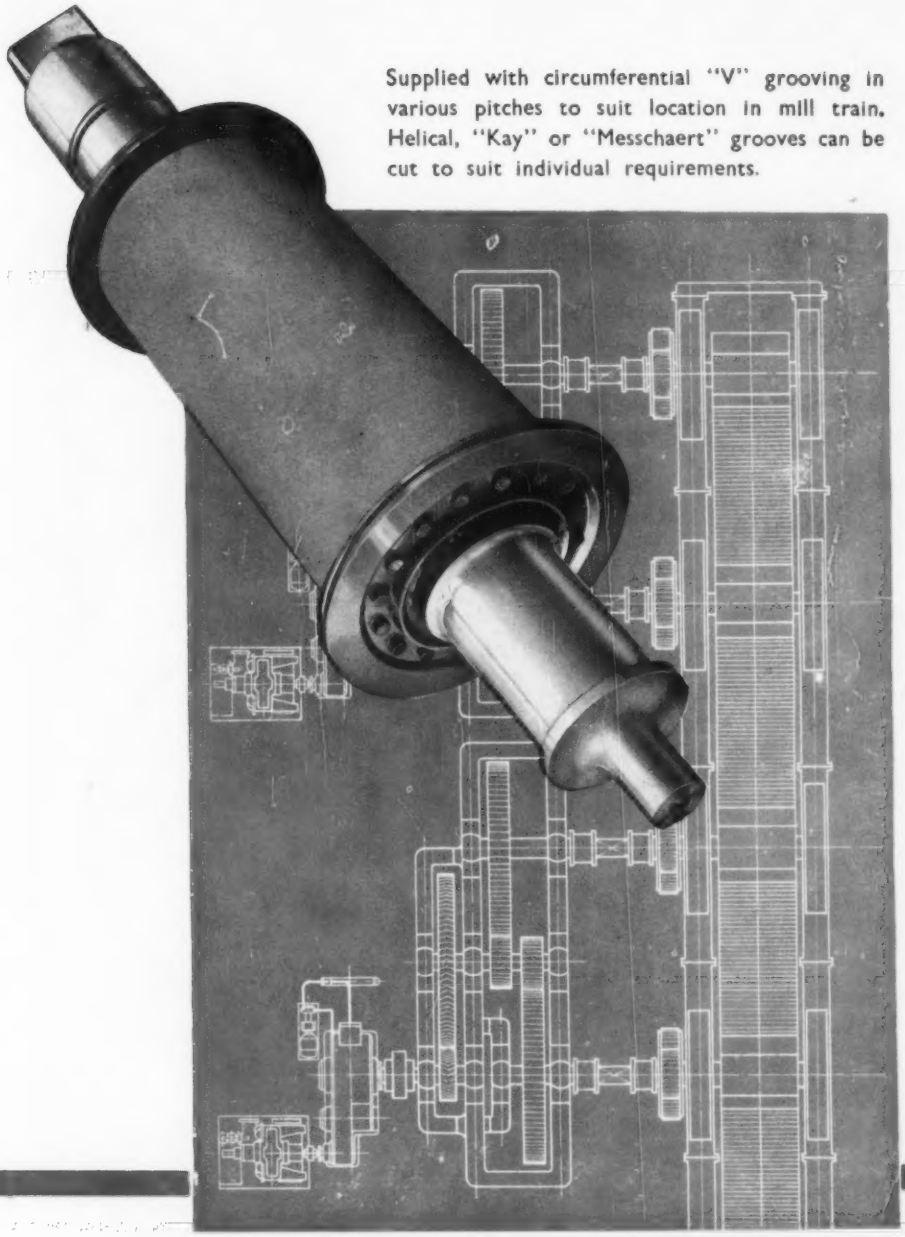

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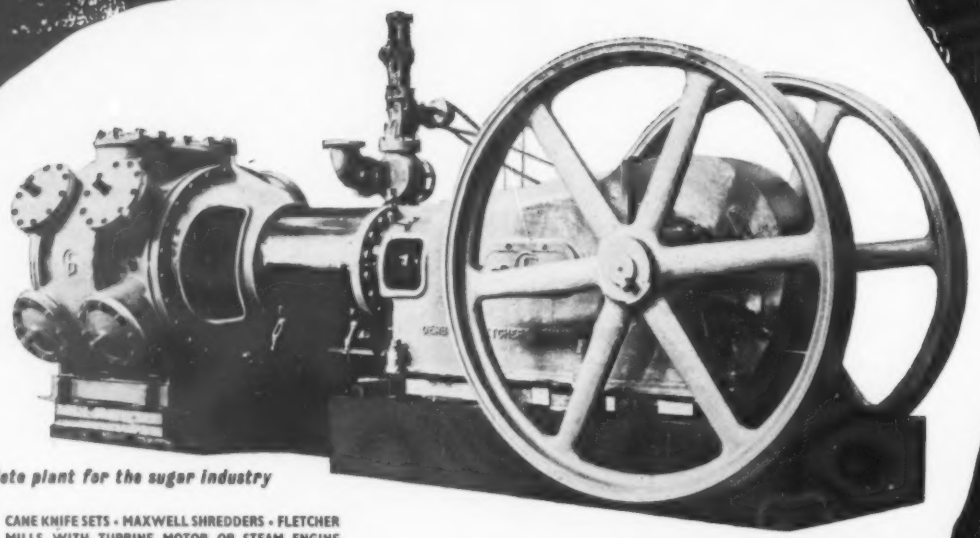

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Keeping in view the above few points, it is concluded that clear juice should be preferred as a medium for remelting sugar as it is economically as well as technologically more suitable.

[It should perhaps be pointed out that the author has not considered that there is often a supply of surplus condensate which does not need heating, so that part of the steam savings referred to above are not necessarily real. In addition, the merit of having lower purity remelt is a matter of opinion. Consequently, it appears that the decision as to remelt in water or clear juice should be taken after consideration of the conditions existing in the factory concerned.—ED.]

THE EFFECT OF CHANGES IN ZETA POTENTIAL UPON THE SEDIMENTATION OF FLOCCULATED MATERIAL IN CANE JUICE

By M. C. BENNETT and N. O. SCHMIDT

Department of Sugar Chemistry and Technology, Imperial College of Tropical Agriculture, Trinidad, W.I.

INTRODUCTION

THE phenomena which take place at the surface of particles during the clarification process have been described in a previous paper[1]: it was concluded that the behaviour of the system is determined to a very large extent by the nature of the particle surface. In this present paper we shall discuss the relationship between settling behaviour in flocculated juices and the electrostatic charge characteristics of the particle system.

The processes leading to phase separation in suspensions have been described[2] as involving three relatively distinct steps : (1) destabilisation, (2) particle aggregation, (3) sedimentation ; each of these steps may be greatly influenced by changes in the electrostatic charge carried by the particles. Much attention has been given[3,4] to the relation between sedimentation behaviour and zeta potential in true lyophobic sols. When zeta potential is large the sol is stable and single sol particles (of true colloid dimensions) settle only very slowly to give a sediment in which the particles are free to assume closely-packed positions ; the sedimentation volume is therefore small. When zeta potential is numerically small, the sol is unstable and the particles flocculate ; settling of the large flocs is rapid but, since the individual particles within a floc are no longer free to move independently, packing in the sediment is of a random nature and the sedimentation volume is comparatively large. KOELMANS and OVERBEEK, for example, have recently demonstrated[5] that the settling time of an Fe_2O_3-in-xylene suspension was markedly reduced when the zeta potential of the system was reduced by the adsorption of long chain fatty acids. More recently the sedimentation behaviour of aqueous suspensions of various minerals has been discussed by LA MER and SMELLIE[6] and by EVANS, KUNDA and CHIANG[7], these authors describing the effects of flocculating agents in terms of possible changes in zeta potential.

The same relationship between stability, sedimentation rate, sedimentation volume and zeta potential does not necessarily exist in lyophilic sols or in particle suspensions stabilised by a surface film of lyophilic material ; the nature of the lyophilic material determines the response of the system to a change in zeta potential. In cane juice, previous studies[1] have demonstrated that the stability of the suspension is extremely sensitive to changes in zeta potential when the numerical value of the latter is smaller than 10 mV, but it was pointed out that this sensitivity is not made use of in the commercial clarification process. Flocculation is in this case brought about by the precipitation of calcium phosphate and the flocs are imagined[8] to consist of clusters of particles bound together in a matrix of the inorganic precipitate. This process is not accompanied by any appreciable change in zeta potential and, irrespective of the value of zeta potential, the flocculated particles are not free to move independently of each other into the most economical packing arrangement in the sediment. The mud volume in a defecated juice is approximately 25 times the total volume of particles and precipitated material.

Nevertheless, it is to be expected that the spatial distribution of particles in a floc will be affected by the charge carried by those particles, for mutual repulsion must tend to increase the separation between individual particles and lead to a less closely packed floc structure than that possible were the particles uncharged. It follows that a change in particle charge should be accompanied by changes in the sedimentation behaviour, a maximum sedimentation rate and minimum sedimentation volume being shown by that system in which the flocculated particles

[1] BENNETT : *I.S.J.*, 1959, **61**, 77.
[2] DORR and LASSETER: "Colloid Chemistry", ed. Alexander, (Reinhold, New York.) 1946, Vol. VI, p. 782.
[3] ALEXANDER and JOHNSON: "Colloid Science", (Oxford Univ. Press, London.) 1949, Vol. II, p. 613.
[4] OVERBEEK: "Colloid Science", ed. Kruyt (Elsevier, Amsterdam.) 1952, Vol. I, pp. 337, 355.
[5] *Disc. Faraday Soc.*, 1954, (18), 52.
[6] *J. Colloid Sci.*, 1956, **11**, 704.
[7] *Canadian J. Chem. Eng.*, 1957, **35**, 25.
[8] BENNETT: *I.S.J.*, 1957, **59**, 208.

carry no net charge, that is, when the zeta potential is zero.

The individual particles, which are considered to be waxy in nature, generally have a predominantly proteinaceous surface and the system behaves like a protein-stabilised oil/water emulsion[9]. Thus, while there are many ways in which the zeta potential of the system might be changed, in this work we are restricted to those methods which cannot possibly affect the matrix of calcium phosphate in the flocs. For example, the particles are isoelectric at pH 3·5 but if acid is added to the flocculated system the calcium phosphate precipitate will have dissolved before zeta potential has dropped more than 1–2 mV. Similarly, high valency cations are precluded because of the possibility of their precipitation as insoluble salts and their inclusion in the inorganic matrix.

In a previous paper[1] have been described the effects on stability of two detergents, the cationic cetyltrimethylammonium bromide (CTAB) and the anionic sodium lauryl sulphate (SLS). These substances adsorb at the oil/water (wax/water) interface, thereby changing the net charge carried by the particle ; it is likely that partial displacement of adsorbed protein occurs. However, great interest attaches to those (abnormal) juices in which the particles carry superimposed layers of polysaccharide material, for it was suggested that the blanketing action of this material, which itself is negatively charged (presumably owing to the presence of $.COO^-$ groups), modifies very considerably the effect of the detergents at the waxy particle surface.

It is the purpose of the present work to show that in a normal juice the sedimentation behaviour of the flocculated system is extremely sensitive to the changes in zeta potential produced by small detergent additions and that any departure from this behaviour in an abnormal juice can provide much information concerning the abnormal conditions existing in that juice.

Experimental

Electrophoretic mobilites were measured by the microelectrophoresis technique which has been described in a previous paper[1]. The juice samples used were those from the settling tubes containing no detergent additions, the settled tube contents being remixed in a blender. The sample was diluted twenty-fold in 0·01 M KCl and the required detergent additions made ; under these conditions the zeta potential could be calculated directly from the Helmholtz-Smoluchowski equation,

$$\zeta = \frac{4\pi\eta}{D} u$$

where η is viscosity, D the dielectric constant and u the mobility. In no case was it possible to measure the mobility of particles under the same conditions as those existing in the settling tubes at 90°C, but in one or two cases it was possible to determine the reversal of charge concentration of CTAB directly on the cooled tube contents, that is, on sediment resuspended in its equilibrium clear juice, which already contained the required detergent concentration.

Sedimentation was observed using a method based on previous work[10] which will be described in detail elsewhere[11] ; eight settlings could be carried out simultaneously in tubes mounted in a water thermostat at 90°C. An attempt was made throughout to ensure complete flocculation at pH 8·0 by adding to the raw juice the minimum quantities of sodium phosphate and calcium chloride necessary to give a clear supernatant in the settling tube. These quantities, determined in a separate experiment, were added to 6 l of raw juice and eight 700 ml aliquots taken. Each of these was adjusted to pH 8 with strong NaOH and the samples heated simultaneously to boiling. When all had boiled for not less than 6 min, the various detergent additions were made and the samples poured as quickly as possible into their respective settling tubes.

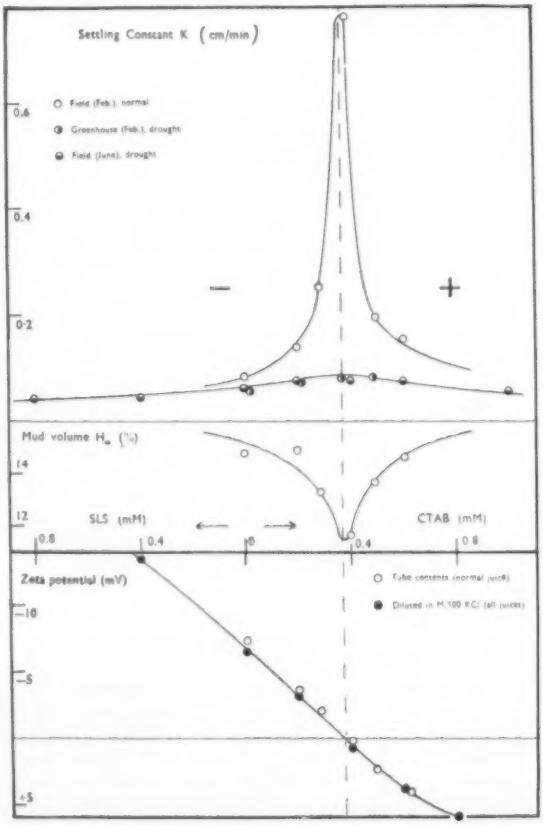


Fig. 1.—Settling constant, mud volume and zeta potential against concentration of SLS and CTAB in samples of "normal" and "drought" (greenhouse and field) B37161 cane juice.

The sedimentation behaviour was assessed in terms of :—

(a) the initial settling rate, V cm/min.

[9] Bennett, *J. Colloid Sci.*, **12**, 434, 1957.
[10] Schmidt : *Proc. 8th Congr. I.S.S.C.T.*, 1953, 729.
[11] Schmidt, *I.S.J.*, in press.

(b) the empirical settling constant, K cm/min. On the basis of earlier work[10], this is defined by $K = (H_\infty/R)^2$, and represents the velocity of the mud interface when the mud volume is twice that after infinite settling time.

(c) the mud (sedimentation) volume, H_∞, which is expressed as a percentage of the original total volume of juice in the tube.

The significance of these terms will be fully discussed elsewhere[11].

Commercial preparations of CTAB and SLS were purified by two recrystallizations before use, and other reagents used were of "Analar" (Analytical reagent) quality.

Results and Discussion

In figure 1 are shown the graphs of zeta potential, K and H_∞ against detergent concentration in three different samples of B 37161 juice. Regarding the juice from field cane cut during February, it was found that the behaviour of the system towards the detergents was entirely as might have been expected from the foregoing discussion and we shall therefore describe this as the "normal" behaviour. In this juice we were able to measure electrophoretic mobilities directly on the cooled tube contents and, as shown in the figure, the reversal of charge concentration obtained was identical with that from the diluted system in 0·01 M KCl. The curve is also that given by particles in raw juice and is, in fact, very similar to the curve found by Bennett and Haydon[12] using myristyltrimethylammonium bromide in an oil/water emulsion stabilised by bovine serum albumin ; they found reversal of charge at a detergent concentration of 0·36 mM. Summing up, firstly, it may be said that the reversal of charge point lies at an expected CTAB concentration. Secondly, it is seen that within 10 mV of the reversal of charge point, the sedimentation behaviour of the juice is extremely sensitive to zeta potential. In fact, as the zeta potential falls from 7 mV to zero, K increases by a factor of 10 and the mud volume decreases by nearly 25% ; the curve for initial settling rate V, not shown here, follows that for K, the rate increasing from 1·8 to 4·6 cm/min over this range of zeta potentials.

Thirdly, it is seen that the maximum value of K and the minimum value of H_∞ lie at the reversal of charge concentration, both curves being symmetrical about this concentration ; at a CTAB concentration of about 0·8 mM, the sedimentation behaviour is almost indistinguishable from that of the original juice, the only difference being that the particle system is now positively charged.

It is these last two features which describe the dependence of sedimentation behaviour upon the electrostatic charge carried by the system and any departure from this type of dependence, or any shift in the reversal of charge concentration of CTAB, must indicate an abnormal condition within the system.

At the time these experiments were being carried out, we had available a supply of the same variety of cane, of approximately the same age, which had been growing in the greenhouse under artificial conditions of drought. In figure 1 it is shown that the sedimentation behaviour of juice from this cane was almost insensitive to SLS and CTAB, while the zeta potential-concentration curve determined on a diluted sample was identical with the curve shown. It is highly significant that 4 months later, after about 10 weeks of natural drought, the field B 37161 behaved indentically with the greenhouse sample ; the experimental points are shown in figure 1.

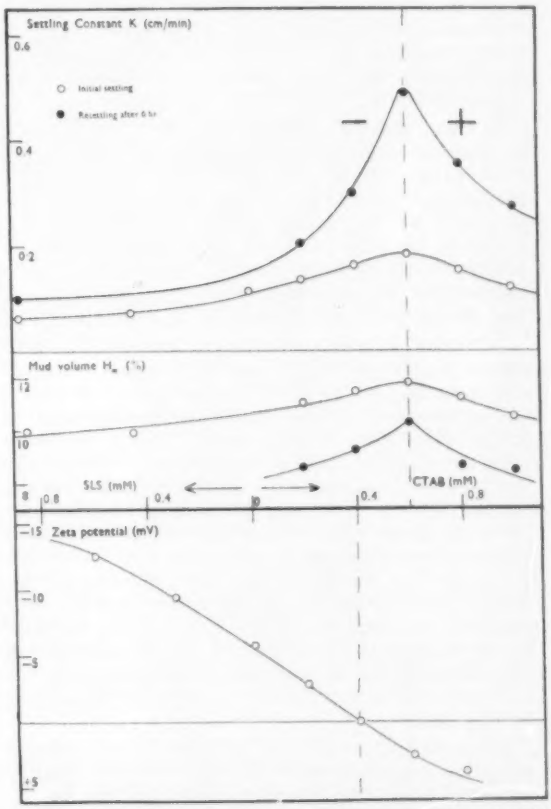


Fig. 2.—Settling constant, mud volume and zeta potential against concentration of SLS and CTAB in "drought" B47419 cane juice. (Initial settling and settling after 6 hr.).

The sedimentation of these two abnormal juices is not, however, completely insensitive to the detergents, for there is a definite rise in the value of K from 0·04 to 0·075 cm/sec as the zeta potential falls from about 10 mV to zero. The maximum in the settling constant curve lies at the same concentration of CTAB, and the reversal of charge concentration is in both cases the same as that determined for the normal juice. Had it been possible to measure electrophoretic mobilities in the settling tube contents, the only predictable change would have been a slight decrease in the slope of the zeta-concentration curve, the reversal of charge concentration remaining at

[12] Bennett and Haydon, *J. Colloid Sci.*, in press.

the same point. Such a change could not possibly account for the observed sedimentation behaviour and we can only conclude that the electrostatic changes brought about by the detergent additions are not accompanied by changes in floc structure. According to the views expressed in a previous paper[1], the abnormal behaviour of these B 37161 juices is probably associated with the presence, at the particle surface, of an adsorbed layer of relatively inert material, a layer which is sufficiently rigid to prevent a closer approach of the particles forming a floc. A decrease in the electrostatic charge carried by these particles cannot now lead to a more closely packed floc structure and hence there is little change in the sedimentation behaviour of the system.

In the previous paper[1] are described certain phenomena associated with B47419 and B4098 juices from canes which had also experienced drought conditions. The nature of the particle surface and behaviour of the particle system in these juices was found to be quite different from that observed in what we shall now call normal juices and therefore peculiarities in the sedimentation response to the two detergents might reasonably be expected.

In figure 2 (open circles) are shown the three curves of zeta potential, K and H_∞ against detergent concentration for the B47419 juice referred to above. One of the most striking features of the sedimentation behaviour is that the H_∞ curve shows a *maximum* with increasing CTAB concentration : this is the reverse of what we expected, and indeed found, in the normal B37161 juice and is the type of behaviour shown by lyophobic sols in which flocculation is itself critically dependent upon a reduction in zeta potential. It is therefore concluded that the stability of this B47419 juice system may be still further reduced by a reduction in zeta potential. This will be reflected by an increase in the degree of particle aggregation (flocculation) and the conditions which apply to the sedimentation of flocculated sols must therefore apply to this juice.

In the zeta potential curve it is seen that the reversal of charge concentration of CTAB (0·4 mM) is slightly increased from that found with B37161 (in fig. 1). The peak values of K and H_∞ lie at an even greater CTAB concentration and we infer that, had it been experimentally possible to measure mobilities directly on the settling tube contents, we should have found the reversal of charge point at this higher (0·6 mM) CTAB concentration. It is likely that this discrepancy arises by desorption of material from the particle surface on dilution prior to electrophoretic mobility determinations, as has been discussed previously[1].

The numerical values of K and H_∞ show that the juice is only slightly sensitive to changes in particle zeta potential, as were the abnormal samples of B37161, but in this case we have the additional information that the layer of interfering or blanketing material must carry an appreciable negative charge. Now when the contents of the settling tube were allowed to stand several hours (at 90°C), and then remixed, it was found that the juice had become very much more sensitive to the detergents ; the results of the resettling after 6 hours are shown in figure 2 (closed circles). At first it was thought that the effect was associated with the compression of particles during the first sedimentation, but this was ruled out when it was shown that increased sensitivity could not be brought about by centrifuging a freshly treated juice at 1000 *g* for 30 min., when a much greater compression effect might have been expected. It was shown that the increased sensitivity was due to a slow process, the effects of which did not become apparent until at least 4 hours after the initial treatment. The fact that the new peaks in the K and H_∞ curves occur at the same CTAB concentration as before shows that, electrostatically, the particle surface has not changed during the process ; the suggestion is therefore put forward that a desorption of part of the interfering charged material originally present at the particle surface has taken place. It has already been suggested that desorption of material takes place in this juice simply on dilution. The fact that the increased sensitivity to CTAB is spread over a much greater range of zeta potential than that found in the normal B37161 juice also tends to support the view that flocculation in this juice is itself dependent upon zeta potential.

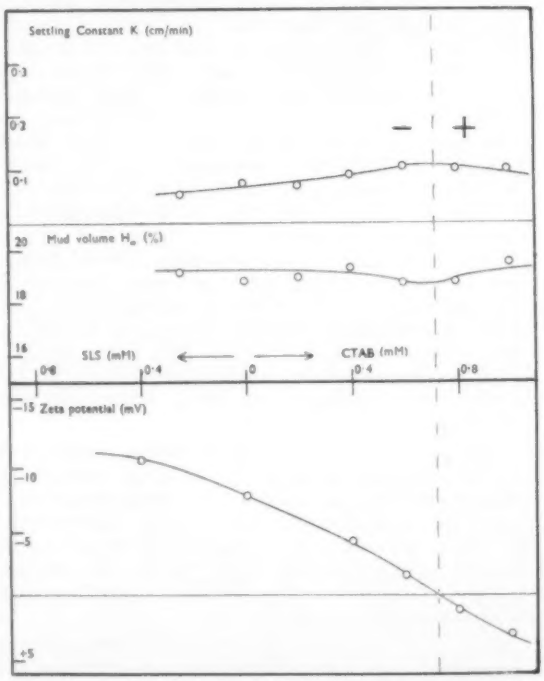
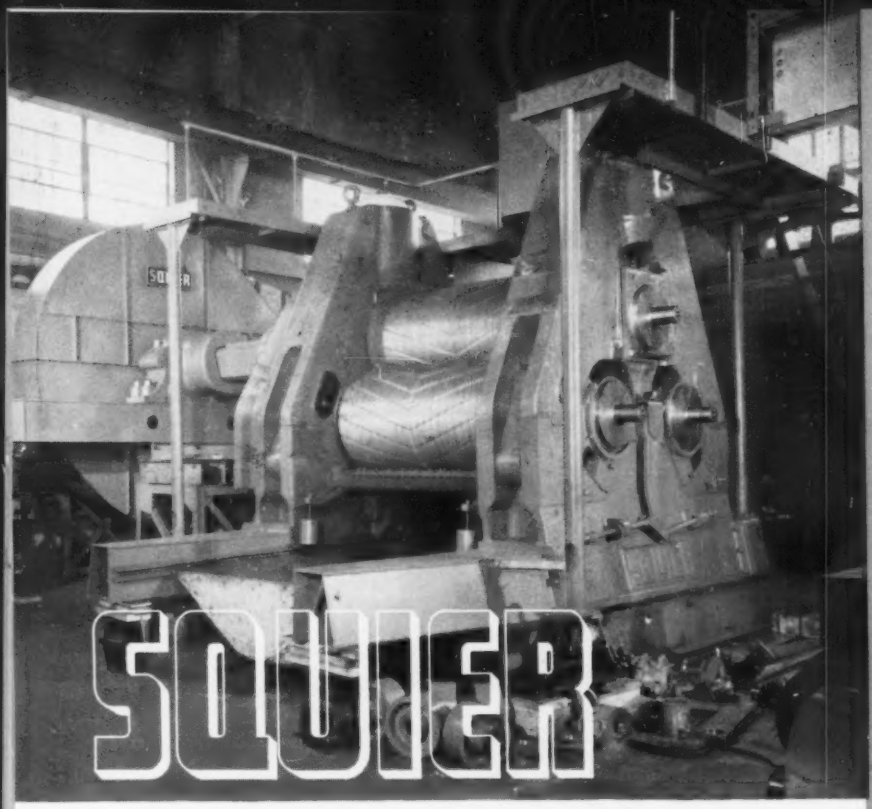


Fig. 3.—Settling constant, mud volume and zeta potential against concentration of SLS and CTAB in "drought" B4098 cane juice.

In figure 3 are shown the results from the B4098 juice in which some marked departures from normal behaviour have already been described[1]. The reversal of charge concentration of CTAB (0·7 mM) is very



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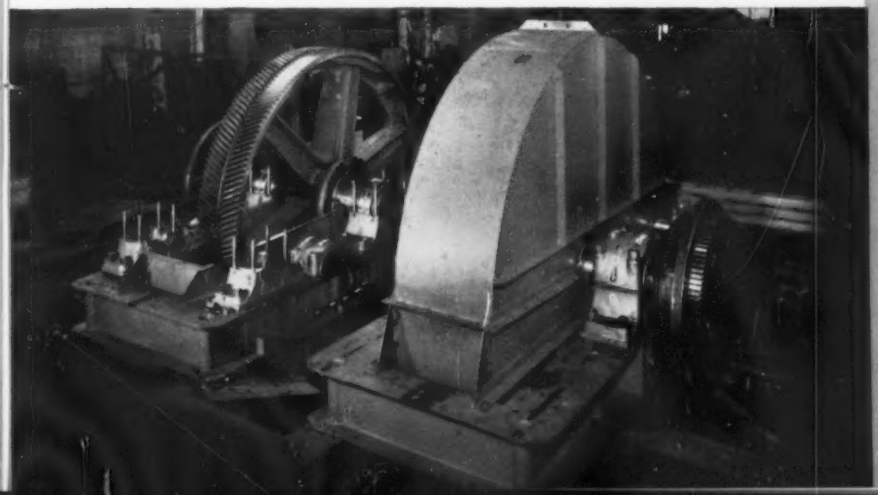

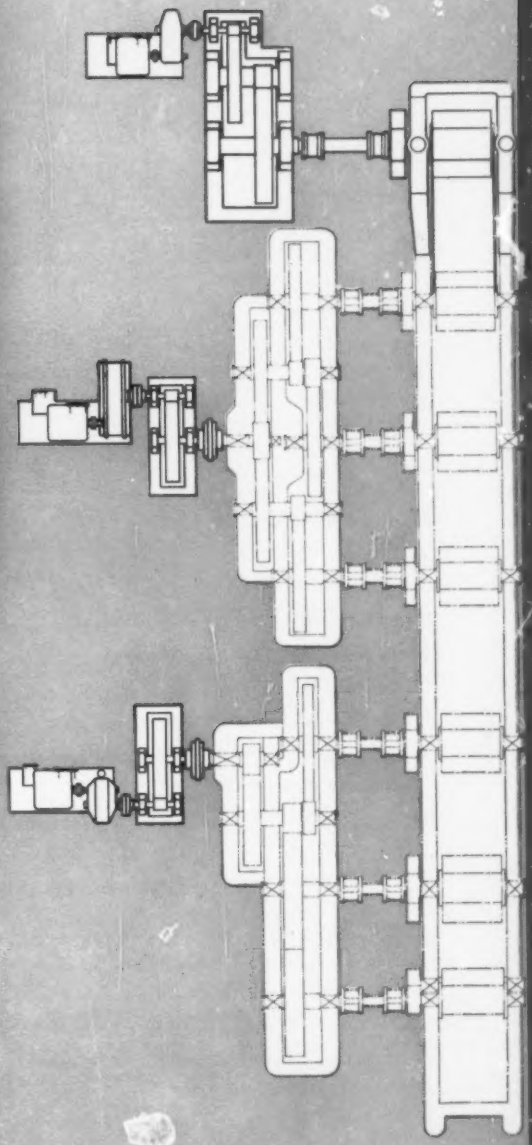

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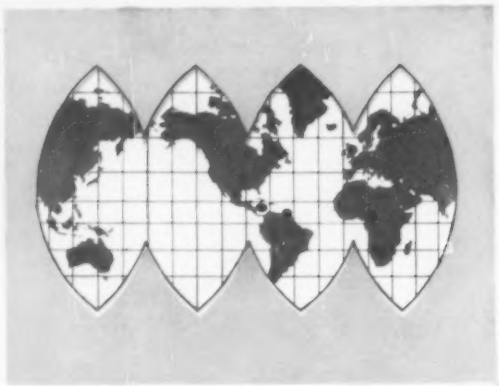

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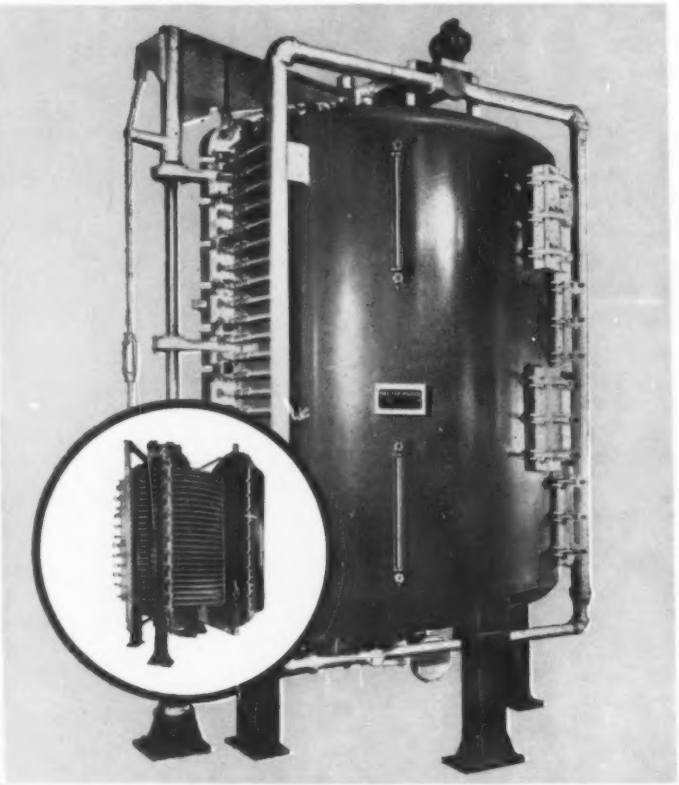

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much greater than in a normal juice and the sedimentation behaviour is almost completely insensitive to the detergent. There is a slight increase in the value of K in the region of the reversal of charge concentration as determined on a diluted sample showing that if desorption did take place on dilution, it was not sufficient to affect the system electrostatically. We could not detect any change in sedimentation behaviour after 6 hours' standing, which again suggests that desorption effects are not important in this juice and leads us to conclude that this juice provides the extreme example of abnormality in both sedimentation and zeta potential behaviour towards the detergents. The particle exchange experiments described in a previous paper[1] were carried out with juice from the B4098 sample and these showed that there was no difference between the particles in this and in the B37161 juice. It must be concluded that the extreme abnormalities shown by this juice are associated with material adsorbed from the continuous phase.

Conclusions

The study reported here serves as a further illustration of the ways in which certain types of material, when adsorbed at the particle surface, can completely change the expected response of the cane juice system to a simple reagent. There can be no question of the commercial use of positive detergents as clarification aids ; their outstanding value lies in their application to the study of abnormal conditions which might exist in "refractory" juices.

We have been fortunate to have available juices which show the various combinations of zeta potential and sedimentation responses to detergent additions and we believe that we have demonstrated:

(a) the existence of an abnormal charged layer on the flocculated particles and,

(b) an abnormal incompressibility of the particles in a floc.

The terms "normal" and "abnormal" have been used to distinguish between those behaviours which were expected and those which were not, but in fact we have no knowledge of which type of behaviour might be found most frequently. The study of the B37161 juices might well be taken to indicate that the condition we have designated "normal" is indeed the usual condition but we lack any such evidence for the "normal" state in B47419 and B4098. Nevertheless it has been demonstrated that climatic and environmental variations are of great consequence in B37161. Similarly we have demonstrated a varietal difference between B37161 and B4098, the latter variety showing a greatly displaced CTAB reversal of charge concentration. We have suggested that this phenomenon is associated with the presence of unusual *charged* material and we must conclude that, under the same climatic conditions, the B37161 variety is not able to generate this type of interfering material.

Acknowledgment

This work forms part of the research programme of the British West Indies Sugar Research Scheme.

SUGAR EXTRACTION USING A SCREW PRESS

By S. G. SMART, A.R.C.S.T., A.R.I.C. and K. G. CARR-BROWN, B.Sc.

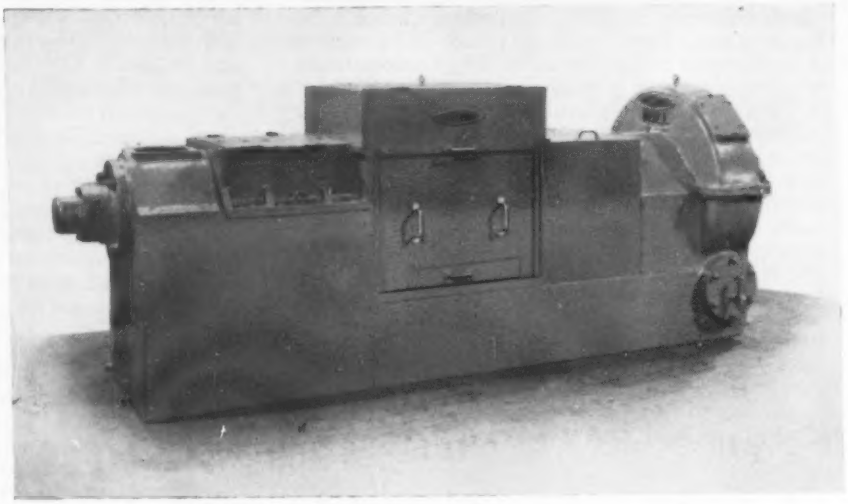
SOME preliminary trials were carried out at the Works of Messrs. Rose, Downs & Thompson Ltd., Hull, using one of their special oil seed screw presses, for the application of de-watering bagasse. These tests appeared to be promising, and it was decided that further tests should be made on a screw press which was despatched to South Africa for some small scale trials. The material used to feed the screw press was bagasse from the last mill of a tandem, and during these tests it was possible to investigate (a) whether a reduction in the moisture content of the bagasse from the last mill was practicable, and (b) whether a corresponding reduction in sugar percent of the bagasse was obtainable.

For the tests in South Africa only a small capacity machine was used and this was driven by a 50 h.p. electric motor. In the screw press the bagasse is de-watered by pressing in a reducing pitch screw which rotates inside a cylindrical cage in which there are perforations for the escape of the liquor. A high pressure is developed in the screw press and some special problems arise. Therefore a number of special construction features have been used in the manufacture of a machine for bagasse de-watering. In the press a steadily rising pressure is maintained on the bagasse for a period of some seconds, thus allowing the dilute juice and water to be squeezed out.

The tests in South Africa indicated that further modifications must be made to screw presses in order to increase their efficiency. The moisture content of the bagasse as fed from the last mill of a tandem was about 51%, which was reduced to about 43%. These results are encouraging when it is realised that certain modifications were required which could not easily be carried out at the time. The sugar content of the bagasse as fed to the screw press was about 2·0% and after emerging it was found that this had been reduced to about 1·6%. The extracted juices showed surprisingly high purities, and averaged about 78 from a number of experiments.

As a further step in investigating the possibilities of the screw press some experiments were conducted with the addition of water to the bagasse as it emerged from the last mill of the tandem and before it was fed to the machine. As a result of this water addition it was discovered that the moisture figure of the wetted material after pressing was no higher than that obtained by the process of 'dry' pressing, while at the

same time a further slight reduction in the sugar content of bagasse resulted. In other words the addition of water was beneficial in helping to increase the sugar extraction without increasing the moisture content over the level of 'dry' pressing. Two such experiments were carried out and it was found that the purities of the resulting juices were generally higher than those extracted without the addition of water, being, on the average 79·5 and 75·8 respectively. The purities of the extracted juices were, in general, equal to or slightly higher than the average reported for the tandem last mill juices. A table is given below showing the analytical figures for the various tests.



	Bagasse						Juice		
	Moisture			Sucrose					
	In	Out	Diff.	In	Out	Diff	Brix.	Pol.	Purity
1	50·0	43·0	7·0	1·9	1·7	0·2	4·85	3·95	81·4
2	51·3	45·6	5·7		—			—	
3	53·7	46·1	7·6	1·9	1·7	0·2	3·7	2·78	75·1
4*	52·6	43·3	9·3	2·0	1·6	0·4	3·3	2·6	78·8
5	52·9	44·0	8·9	1·9	1·5	0·4	3·51	2·68	76·4
6*	51·7	43·6	8·1	2·2	1·7	0·5	2·61	2·09	80·1

* Maceration water added before pressing.

On the basis of the above figures it is estimated that an increase in milling extraction of about 1·5 to 2·0% was obtained. It is anticipated that with further modifications to the screw press, this figure could be improved upon and result in (a) a much lower final moisture content in bagasse and (b) a higher milling extraction.

It is advocated that initially a screw press could be added to an existing milling train with beneficial results and further that they could replace, progressively, the conventional milling plant. Using screw conveyors between presses, the maceration water would be thoroughly mixed into the bagasse before it enters the next unit in a tandem made up of such presses. The result would be a reduction in the number of units required to give a higher milling extraction and reduced moisture in final bagasse at a processing rate of from 1000 to 2500 tons of cane per day. A similar or reduced h.p./ton fibre/hr requirement and a considerable saving in capital expenditure are anticipated. A reduction in the moisture content of the final bagasse will result in a higher calorific value so that a possible saving of this material for use in paper or other manufactures as a raw material commands attention for further consideration. Milling extractions of 96-98% are well within the capabilities of a screw press tandem up to 4/5 units with a capacity of the order of 13/15 tons of dry fibre per hour.

Economics of the process

Assume that the following data is valid for the type of cane processed :

Fibre % Cane ..... 13·5
Sucrose % Cane ..... 13·0
Purity of Last Mill Juice .. 79.5%

	Milling	*Screw Pressing*
Moisture % Bagasse	52·15	43·5
Sucrose % Bagasse	2·1	1.65
Fibre % Bagasse	45·21	54·43
Bagasse % Cane	29·86	24·8
Sucrose in Bagasse % Cane ..	0·63	0·41
Extraction	95·1	96·85
Increase in extraction		1·75

Increase in tons sugar/100 tons Cane = 1·75 × 0·13 = 0·22
Assume Boiling House Efficiency is 90 .
Tons sugar in bags/100 tons Cane (increase) = 0·22 × 0·9 = 0·2
Assume crushing rate of 2500 tons/day, and duration of season 100 days.
Increased sugar in bags per season = 0·2 × 25 × 100 = 500 Tons.
Assume price of sugar is £30 per ton.
Increase in monetary value/season of 100 days = £15,000
Assume £1000 required for extra processing, bagging, etc.
Nett increase in monetary value/season of 100 days = £14,000.

It will be seen from the above that even with a milling efficiency of the order of 95% there is a possibility of increasing this still further and improving generally the output of a 2500 ton factory by about 500 tons of sugar per 100 day season. The return on capital invested is therefore considerable and appears well worth further consideration.

Continuous Carbonatation with the help of a pH Recorder-Controller. B. M. MILLER. *Sharkara*, 1958, **1**, 154–157.—Continuous first carbonatation has been used successfully during the last three seasons at Champarun sugar factory. Lime addition is controlled by juice flow and the gas supply is controlled pneumatically from a Kent Universal pH recorder/controller. The glass electrode must be cleaned three times a day by wiping with cotton wool soaked in dilute HCl, and the sample hopper, reference electrode and resistance thermometer must be descaled occasionally. Adjustment is necessary to give the increased sensitivity needed for control of second carbonatation, but this is possible, and when so used, the electrodes are not scaled, so that the instrument can be used continuously without attention.

* * *

Babbitt Linings for Mill Bearings. B. B. KAMAT. *Proc. 15th Conv. Deccan Sugar Tech. Assoc. (India)*, 1958, 62–64.—Details are given of the application of babbitt metal lining to a phosphor-bronze backing and used as the bearing for the top roller of a 3-roller crusher. Results were encouraging over one season, and it is proposed to try the babbitt on a suitable steel bearing.

* * *

"Gul Studies" at the Sugar Cane Research Station, Padegaon. G. T. BABRIWALA and R. A. KALE. *Proc. 15th Conv. Deccan Sugar Tech. Assoc. (India)*, 1958, 82–88.—Brief accounts are given of work on the causes of deterioration of gul quality and colour, trials to improve quality and colour, and work on the problem of gul spoilage during storage.

* * *

Studies in Gur Manufacture. Strike Temperatures of Sugar Solutions. A. J. DANGRE. *Proc. 15th Conv. Deccan Sugar Tech. Assoc. (India)*, 1958, 115–118.—Boiling point data for sucrose solutions[1] and saturation concentration data[2] are combined as two series of curves on a single graph. The points of intersection indicate the temperatures at which strikes of various purities should be dropped. The high temperature corresponding to a purity of 80 and the increase in temperature on release of the latent heat of crystallization, means that the risk of caramelization is so great that solutions of purity less than 80 should not be used for gur manufacture.

* * *

Mill Settings. A. VAN HENGEL. *S. African Sugar J.* 1958, **42**, 855–861.—A comparison is made between mill settings calculated by the S.M.R.I. method[3] and the Mauritius method[4]. It is concluded that the latter is based on incorrect theory, although the Mauritius settings give good results. This is explained by the fact that the average lift of the top roller is not as high as assumed in the Mauritius method and is more in line with the lift assumed in the S.M.R.I. method.

* * *

Use of "Versene"—Possibility of Increasing the Exhaustibility of Molasses. J. M. SAHA, D. L. N. RAO and –. VIRENDRASINGH. *Indian Sugar*, 1958, **8**, 381–384, 399–406.—Further experiments lead the authors to refute the claims of RAO *et al.*[5] as to the increase of pol of molasses on addition of EDTA and the possibility of its further exhaustion.[6]

* * *

Factors affecting Loss of Sugar in Sugar Factories and their Relative Preventative Measures. K. P. MITTAL. *Indian Sugar*, 1958, **8**, 387–392.—Brief notes are given on the extent of and methods for reduction of losses in the field, loss of pol in cane in transit, loss by drying of cane, loss during milling (as bagasse loss and by inversion), loss in clarification (press cake and inversion losses), entrainment losses and molasses losses.

* * *

How to Modernise your Sugar Mill. E. C. NIESTRATH. *Sugar y Azúcar*, 1958, **53**, (12), 22–25.—Modernization and augmentation of existing plant has raised the capacity of Ingenio San Carlos, Ecuador, from 1200 to 4000 tons/day. The steps involved are discussed and a modernization programme is proposed. In this machine-moulded gears are replaced by machine-cut gears of proper ratio; inadequate existing engines are replaced by steam turbines; old mill housings are replaced by new housings of modern design; cane knives are installed; additional mills are installed in the tandem; maceration is increased; forced feed rollers are installed; long-toothed crown wheels are fitted to accommodate larger roll openings; and the equipment is maintained in first-class condition.

* * *

Supreme Sugar Refinery Controls Fermentation Odours. ANON. *Sugar y Azúcar*, 1958, **53**, (12), 33.—Odour counteraction is the combination of two or more odoriferous materials in such proportions that all become less perceptible. Two odour counteractants

[1] SPENGLER *et al.*: *Zeitsch. Wirtsch. Zuckerind.*, 1938, **88** 521–608; *I.S.J.*, 1939, **41**, 26.
[2] DE VRIES: *Archief*, 1941, **1**, 543–555; *I.S.J.*, 1942, **44**, 77.
[3] VAN HENGEL & DOUWES DEKKER: *Proc. 33rd Congr. S. African Sugar Tech. Assoc.*, 1959.
[4] HUGOT: "La Sucrerie de Cannes" (Dunod, Paris). 1950, p. 156.
[5] *I.S.J.*, 1958, **60**, 298 ; 1959, **61**, 183.
[6] See also *I.S.J.*, 1959, **61**, 50.

added to the waste vat at Supreme refinery by a drip feed were found to give completely effective odour control.

* * *

A New Method of Controlling the Burning of Bone Char. V. E. GEL'MAN and I. YA. FUKSMAN. *Sakhar Prom.*, 1958, (11), 31–32.—Preliminary tests, using normal, under-burnt and over-burnt char and brass electrodes 100 mm apart, showed that at 25°C, the respective mean resistances over 5 tests were 12–25 kΩ, 100–180 MΩ and 100 MΩ. Similar tests were made, with the electrodes 20 mm apart, in which the char was heated to glowing. The mean resistance values over 3 tests were 1–3 kΩ for normal char, 150–180 MΩ for the under-burnt char and 500 MΩ for the over-burnt char. Stainless steel electrodes were used in the factory tests and measurements were made at 1100–1150°C. The kilns were operated as normally, assuming a discharge of char every 70 min. With 23 min still to go to the end of the normal period, experimental discharging was carried out. The char resistance was measured and found to have dropped from 5 to 0·4 kΩ. The quality of the char throughout the test period was good. This method is suitable for controlling char burning and cut the burning time by 10–15%. The use of an electric impulse to permit automatic control is suggested.

* * *

Capacity of Sugar Cane Mills. K. J. BULLOCK. *Sugar J.* (La), 1958, **21**, (5), 11–17; (6), 26–29; (7), 13–20.—An experiment was carried out to measure the effect of pressure, cane preparation, speed of rubbing, surface condition (smooth or grooved) and fibre dryness on the dynamic coefficient of friction between the cane sample and the mill roll. In general the grooving increased the coefficient by 60% but this is dependent on the pressure and below 20 p.s.i. no effect occurred. For fresh cane, the coefficient was virtually independent of preparation and juice content while, when feeding coarse fresh cane at 20 p.s.i., there was a general decrease in friction with speed (shown separately to follow the equation $\mu = 0{\cdot}43 - 0{\cdot}002S$ where S = speed in f.p.m.). With fibrated cane with 60% of the juice removed μ was reduced from 0·43 at 10 f.p.m. to 0·27 at 60 f.p.m. The limiting coefficient was measured for oven-dry and fresh cane, fibrated and coarse, and was found to be considerably higher than the dynamic values, and increases significantly and almost linearly with pressure. Recent figures are quoted for the coefficient of friction between bagasse and various plane surfaces including cast iron, cast steel and aluminium (all as cast and machined), and a rough surface. The dynamic coefficients varied between 0·37 and 0·53 and the limiting value between 0·62 and 0·73. Grooving, it is assumed, would increase the values by 25%. The value of μ decreases with increasing pressure, the most rapid fall being between 0 and 3000 p.s.i., and can reach 0·06 at 12,000 p.s.i. for fine preparation on a smooth surface. The compressibility of cane is a factor which invalidates the "angle of nip" theory of mill feeding and a more complex theory is needed to explain the dependence of mill capacity on compression ratio. The density of cane fibre can be expressed by the formula $\rho_F = 1{\cdot}512 + 1{\cdot}61 \times 10^{-6} P_A \pm 0{\cdot}01$ g/cc, where ρ_F = density (g/cc) and P_A is the pressure in p.s.i. This corresponds to a density of 94·5 ± 0·6 lb/cu. ft. at atmospheric pressure. It is reasonable to assume that bulk density of cane in the feed chute as high and uniform as possible will give better feeding. The quantitative importance of tensile strength and the ratio of "transverse" to "longitudinal" pressure in the mill is not known but may be quite important, as may the shear strength. An examination of the coefficient of dynamic friction when feeding whole stalks indicated that the "angle of nip" theory was valid for such conditions. Experiments feeding pre-compressed slabs of cane of accurately measured thickness gave juice extractions which showed that the mill capacity increased fairly steadily with speed, probably reaching a maximum at 100 f.p.m. A factor C_N—a dimensionless number defining the feeding ability of the mill—is calculated as $\frac{W}{\rho_{PC} S D}$ where W = mill capacity per foot width in lb/min/ft; ρ_{PC} = bulk density of prepared cane in lb/cu. ft.; S = roll speed in f.p.m. and D = roll diameter in feet. This factor C_N or capacity number decreases with increasing roll speed, but when drawn as a graph shows a point of inflexion at 50 f.p.m. This might be the cause of an apparent point of inflexion observed at 60 f.p.m. when plotting juice extraction with a mill having juice grooves. Randomised experiments to discover the effect of feed depth on feed pressure were carried out so as to avoid the effects of the other variables; it was evident that for a speed of 25 f.p.m. the feed pressure was practically independent of feed depth and depended on preparation; feed pressure for fibrated cane is zero, and the slope of the feed pressure-feed depth graph increases with coarse preparation and with speed. At a compression ratio of 1·5 the feed depth has no influence on feed pressure; as the compression ratio rises, however, the pressure increases more steeply with depth. Consequently the bad effects of a close feed roll setting with a thick blanket and coarse preparation becomes obvious. An equation

$$P_F = \frac{F}{H} = \frac{\theta \int^{\alpha} P_\beta \tan(\beta - \alpha) \cos\beta \, d\beta}{\frac{1 + \frac{n}{D}}{2} - \sqrt{\frac{(1 + \frac{n}{D})^2}{4} - C_N}}$$

is developed, where P_F = feed pressure, F = feed force per foot of blanket width, H = feed depth, $\alpha = \tan^{-1}\mu$ (μ = coefficient of friction), θ = angle of contact at the roll surface, P_β = longitudinal compressive pressure exerted by a column of bagasse on the roll surface at angle β, due to the compression of the cane; n = the work opening (ft); D = roll diameter (ft) and C_N = capacity number. This equation is necessarily of limited accuracy because of intervening factors which cannot be quantitatively accounted for, but provides a reasonably quantitative

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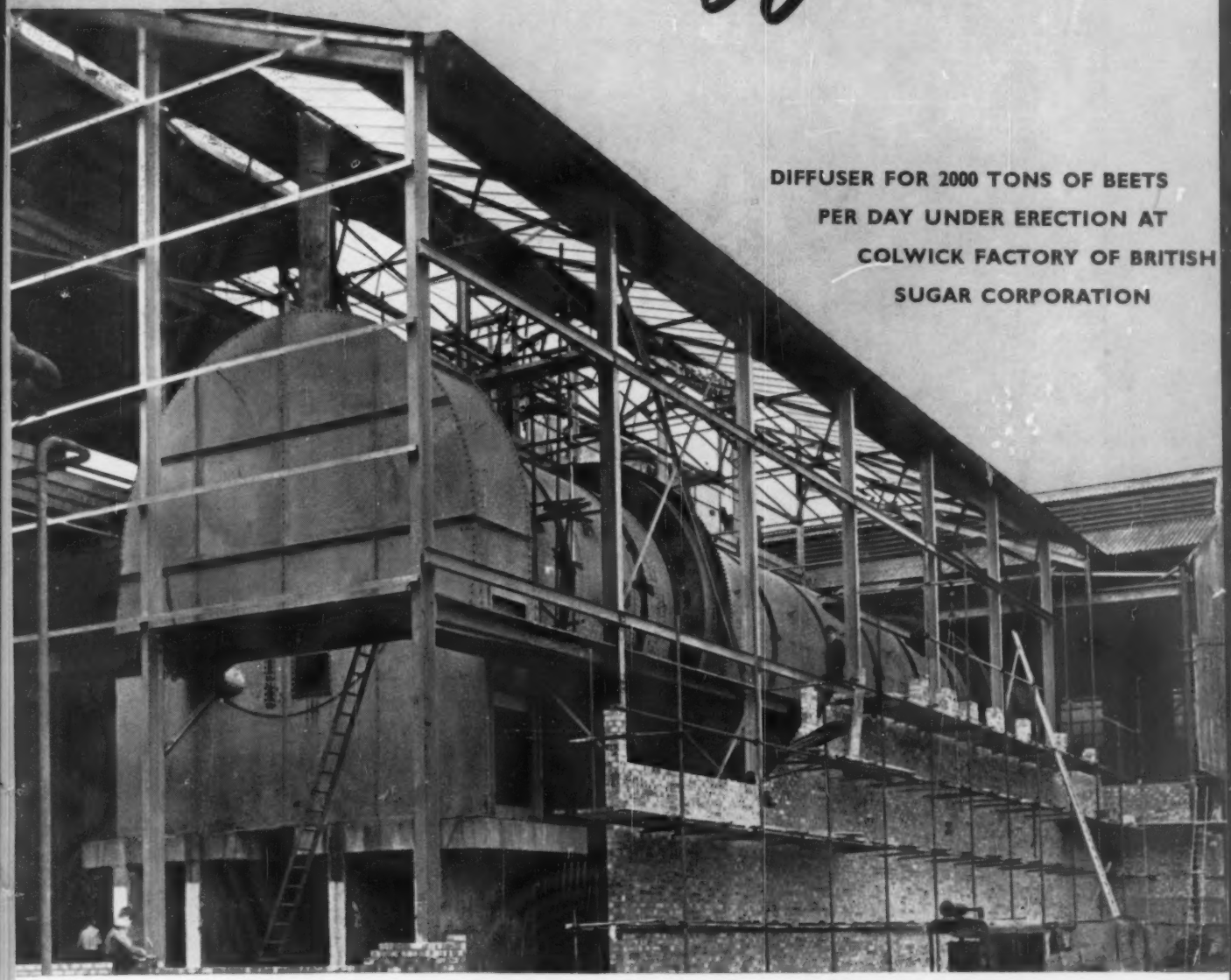

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answer to the feeding problem. From its theoretical basis, it can be seen that feed pressure increases with increasing compression ratio, increasing capacity number, increasing roll speed, and increasing coarseness of preparation. The suitability of the equation is also checked by comparison with data recorded elsewhere. The relative influences of preparation and feed chute pressure on the relative density of prepared cane and the no-void density is discussed. The equation assumes a constant value of μ from θ to α, which for high compression ratios is one of the chief sources of error; substitution of measured feed pressures in the equation gives a series of values of μ which decrease with increasing speed and increasing compression ratios; and interaction between these two is indicated.

* * *

Instrumentation and Automation of the Pans. J. M. SALINAS. *Bol. Ofic. A.T.A.C.*, 1958, **17**, 617–620.—A brief discussion refers particularly to the hydraulic operation of valves on the pan floor of Central Fidencia under centralised control.

* * *

Water Consumption and Quantity of Waste Water in a Refinery. A. P. PARKHOMETS. *Sakhar. Prom.*, 1958, (12), 15–17.—Optimal water requirements of Berdichev refinery are calculated to be 2200% on refined sugar, compared with an actual consumption of 2730%.

* * *

New Automatic Line for Pressing, Drying and Packeting Refined Sugar. V. A. CHEREDNIK and B. G. KOLESNIK. *Sakhar. Prom.*, 1958, (12), 31–37.—The fully automatic Chambon equipment installed at Krasnopresnensk refinery in 1958 is described and illustrated. A rotary press operates at 9 r.p.m., 720 tablets (27·3 × 17·4 × 11·1 mm) weighing 5·5 g being pressed out per revolution. They are placed on trays which pass to the drying tower where during 25 minutes at a maximum of 70°C they are reduced from 1·6–1·8% moisture to 0·15–0·20%. The trays are conveyed to a vacuum-operated packeting machine where the sugar is packed into cartons of 3 layers of 60 tablets. The cartons are weighed and those not of standard weight rejected automatically. They are provided with a lid, sealed automatically and passed through a printing machine.

* * *

Methods of Bulk Transport and Sugar Storage. P. K. POPOV. *Sakhar Prom.*, 1958, (12), 43–46.—Various bulk handling techniques in the U.S.A., Canada and Great Britain are discussed. These include a special rail wagon with provision for pneumatic loading and unloading; liquid sugar road tankers and the "Totebin" system[1]. Silo storage in the U.S.A. and Canada are also discussed and the savings in manpower and money made possible by bulk handling are shown to be considerable.

* * *

Conversion to Streamlined Bagging of Refined Sugar. V. YA. BRAGINSKII. *Sakhar. Prom.*, 1958, (12), 47–48.—A unit is described in which cube sugar is bagged and the bags passed along a belt conveyor to scales and thence to a sewing machine. Capacity is three bags per minute.

* * *

Packing Refined Sugar in Large Packets. M. N. TARASOV and M. B. YARMOLINSKII. *Sakhar. Prom.*, 1958, (12), 48–49.—Packing ½-kilo packets of refined sugar into kraft paper bags holding 40 packets is recommended instead of the usual Soviet Union practice of packing in wooden or cardboard boxes holding 100 packets.

* * *

"AC" System of Sugar Manufacture—Results Obtained. R. ESPARZA TABARES. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 45–52.—An account is given of the two-massecuite system[2] as adopted at Central Sta. Lucía since 1955, together with a note of the ensuing benefits.

* * *

Preclarification of Juice. J. R. DE LA VEGA. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 53–68.—In experiments on treatment of juice with Al salts it had been noted that a precipitation occurred between pH 3·2 and pH 3·7. This phenomenon is discussed with references to the literature and a series of comparisons made by examination of juices and mud produced (i) by simple clarification, (ii) by double clarification where the juice is pretreated with acid to the required pH, settled and the supernatant defecated in the usual manner, and (iii) where the acid used in (ii) is SO_2. It was found that the last method increased wax removal by 29·5% and nitrogen elimination by 34·5%. The purity increased by 1·5–6·35 units which more than compensates for an inversion loss of about 0·02% during 2½ hr retention under acid conditions in the cold.

* * *

Determination of Heat Transfer in the Evaporators as a Method of Measuring the Relationship between Scale and Efficiency of Cleaning Operations. P. HONIG and F. DE MIGUEL. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 69–78.—The evaporation station at Central Palma comprises three quadruple effects. By measuring the quantity of condensate leaving the calandria of the last body, temperatures of the vapour at the entrance of the calandria of the last body, of the condensate and of the syrup, heat transfer could be calculated; the results showed the great variability of the evaporator performance but were sufficient to indicate how the heat transfer coefficient changed with time and on cleaning the evaporators. The measurements indicated when cleaning had been inadequate and it is suggested that daily measurements over a number of crops and for evaporators of different designs, dimensions, etc., might provide useful data to aid the design of new units.

[1] See *I.S.J.*, 1957, **59**, 294.
[2] See *I.S.J.*, 1957, **59**, 186.

Influence of the Design on the Efficiency and Capacity of the Evaporation Apparatus. J. C. González Maíz. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 79–82.—Details are discussed of the design of a Honolulu Iron Works Co. evaporator which has an efficient performance.

* * *

The Use of Steam Flowmeters in the Pans. A. L. Webre. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 83–86.—Steam flowmeters were installed on the pans at Pennsylvania Sugar Co. so as to find the steam requirements and hence the size of Ruth's steam accumulator which should be installed. Afterwards they were useful in establishing a relationship between steam usage and the condition of the massecuite. If a pan is fitted with mechanical circulation and automatic feed, the latter can be adjusted so as to maintain maximum steam demand establishing an adequate consistency for the strike. On reaching the maximum level the feed can be adjusted to give the desired Brix. Details of such a technique are discussed.

* * *

Calculations in the Massecuite Systems. F. García López and J. A. Clark. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 87–105.—Quantities of massecuites, molasses, sugars, steam, etc., are calculated for a number of boiling systems including 2-, 3- and 4-boiling schemes.

* * *

Notes on the Final Strikes in the Crystallizers. R. V. Escalona. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 107–112.—Notes are provided on five years' experience at Central Santa Marta, where the crystallizers are stirred U-troughs with cold water circulation through 1-inch copper pipes running spirally along the length of the trough and fastened to the stirrer arms. Massecuites struck at 160–165°F are cooled to 60–65°F in about 20 hours. Experimental variation of operating conditions has shown that (i) massecuites with optimal nucleus concentration, number and uniformity can be cooled rapidly without new grain formation or drop in efficiency ; (ii) a compromise has to be made between having maximum nuclear surface per unit volume (hence small grain) for good "crystallization in motion" and adequate porosity to permit good purging in the centrifugals; (iii) the best method is to cool the massecuite rapidly and to keep it cool and in motion as long as possible up to 96 hours (after this time the increased exhaustion does not compensate for inversion losses); (iv) addition of hot or cold water should be avoided; (v) the massecuite should be heated for a minimum of time before purging, in a mingler so as not to waste the cooling capacity of the crystallizers ; (vi) third massecuite may be well exhausted in 60-hr cycles in crystallizers with forced cooling; (viii) where there is an initial temperature difference of 75°F and cooling water does not go over 85°F a factor of 0·3 sq. ft. cooling surface per cu ft. of massecuite can be used to calculate the heat transfer surface, with copper tubes; (viii) for relatively rapid heating, the heating surface in the mingler should be 1·5–2·0 sq. ft. per cu. ft. of massecuite and the heating water at an automatically controlled temperature of 180°F so as to get uniform heating of the massecuite to no higher than 125–128°F; and (ix) good crystallizer performance is considered to be when a maximum of sucrose is recovered in a minimum of time and at the same time giving a clean high-purity magma.

* * *

Purities of Low-Grade Strikes. R. Esparza Tabares. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 113–117.—Average figures over five years are presented in which the 2-boiling system was employed and C-strikes were boiled at a purity of 61·0-67·0 while maintaining the crystal concentration constant at 44% and all other variables–footing volume, crystallizer cycles, etc.—as constant as possible. Gillett's findings[1] that best exhaustion was obtained at 64–66 purity, an increase in molasses purity occurring outside this range, were confirmed, the optimal value under Central Santa Marta conditions being 66·0, when the purity drop from massecuite to molasses was 31·0 units compared with 24·0 units from a 61·0 purity strike. Total sugars in molasses were 52·83% and C-sugar purity was 87·0. Pan yield was 65%, and purging was improved, compared with strikes of lower purity. Molasses production was lower and boiling time reduced, while handling was much easier.

* * *

Control of the Variables Determining Grain Size in the Manufacture of Raw Sugar of Large Crystal Size. F. García López and J. A. Clark. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 119–134.—The relation of final crystal size to seed size is calculated in terms of the purities of seed, syrups, molasses, sugar and final massecuite. Three examples of the use of the formula are worked out. A series of graphs are also given relating syrup purity with grain size of sugar, sugar solids : syrup solids ratio, etc. Four methods of controlling the final grain size are : to maintain the seed size at a minimum and to dissolve part of it ; to maintain a seed size such as will give satisfactory exhaustion of final molasses; to dissolve all seed and establish grain on commercial strikes; and to vary the seed size by means of the weight of powdered sugar employed. The advantages and disadvantages of each are mentioned.

* * *

Burnt Cane. A. de Mena y Vaillant. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 149–154.—The milling of burnt cane and processing of its juices is calculated to increase pol losses in milling, cause difficulty and increase lime consumption in clarification, and impair crystallization, in comparison to unburnt cane.

[1] "Low Grade Sugar Crystallization".

BEET FACTORY NOTES

Technological Scheme of Beet Sugar Production in the U.S.S.R. V. V. YAPASKURT. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 759–774.—The characteristics of the individual factory process adopted in the Soviet Union are discussed.

* * *

Questions of Water Economy in Juice Extraction. G. OPLATKA. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 783–807.—Water requirements in Robert battery diffusers is discussed. Instead of using part of the fresh water to push water from the last vessel into the previous one, it is suggested that the fresh water be added during draw-off and pumps installed between vessels. This scheme has already proved satisfactory in practice, and has other advantages besides cutting fresh water requirements. The use of press water return is recommended as an economy measure. The optimal point at which to add the press water is discussed and expressed as the approximation $\frac{h}{H} \simeq 1 - \frac{0{\cdot}85}{\lambda T}$, where H is total battery length, h is the length of the battery beyond the point of return water addition, λ is an undefined "diffusion factor" and T is extraction time. This applies in practice where $\lambda > 8$ and where the weight of juice extracted beyond the return point is 0·6–0·8 on weight of cossettes. Juice and cossette concentration curves are drawn, illustrating their changes near the return water point.

* * *

Effect of Juice Circulation on the Speed of the Diffusion Process. S. ZAGRODZKI. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 808–818. Fick's law is not applicable to diffusion unless the concentration of sugar at the cossette surface is the same as that of the average concentration of sugar in the juice. Since sugar is still diffusing through the stationary juice layer next to the cossette, Fick's law and the formula usually derived from it are applicable only for the limiting case of complete mixing. A modified formula is derived for the conditions in practice. To accelerate diffusion, rapid flow is needed. Laboratory experiments have shown that juice recirculation in each cell of the battery by means of rotary pumps gives up to 5% increased juice concentration, reduced sugar in pulp, and a 15% reduction in diffusion time.

* * *

Factory Trials with Fractionated Saturation and Continuous Filtration. P. PAVLAS. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 819–837. Experiments on saturation in a variety of ways have shown that the effects upon the sedimentation and filtration properties of the juice of various factors tending to produce larger sludge aggregates are additive. The best results were obtained by progressive preliming, fractional saturation to oversaturation of a first fraction, return of one third of the oversaturated juice to the diffusion juice, and simultaneous liming and carbonatation of the second fraction to normal saturation point. The method is suitable for continuous operation, and a flow diagram is given. Results at Klobuky factory confirmed the advantages of the process. Preliming at 60°C (instead of 85°C) gave much worse results, depending on the quality of the beet.

* * *

Sweetening-off First Carbonatation Muds with Fresh Water and Diffusion Water. S. ZAGRODZKI and H. ZAORSKA. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 838–849.—See *I.S.J.*, 1956, **58**, 256.

* * *

Filter Press with Hydromechanical Muds Removal. The Roman Szarejko System. R. SZAREJKO. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 850–858.—Details are given of the Szarejko filter press[1]. The filter is made in two sizes, one having a single row of plates of 115 sq.m. filter surface, and the other with a double row of plates of 225 sq.m. filter surface. The complete cycle takes 4–6 hours. Advantages of the filter are discussed.

* * *

Use of Ion Exchangers in the Sugar Industry. R. WILLER. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 859–866.—The size of filters and amount of resin may be reduced by treating 1st product run-off instead of thin juice. Small scale experiments using this run-off yielded a clear water-white juice which could be boiled to a high purity white sugar (raffinade) and giving a pale yellow mother liquor part of which could be used for washing 1st product sugar. The scheme can be used for liquid sugar production.

* * *

Central and Local Summarization and Recording Control. K. SANDERA. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 917–927.—As a step toward factory automation, a central control panel was set up in Modrany sugar factory in 1955, making possible remote control of 22 different stations in the factory. Apparatus was also installed for translation of laboratory results to the factory control units and to the dispatcher room. Apparatus has also been installed for remote control of valves and the more important motors, and the whole system, including signal lamps, connected so as to permit complete factory control from the one central point.

* * *

Effect of Calcium Carbonate and Muds on Juice Coloration and Evaporator Scale Formation. R. SZAREJKO, S. ZAGRODZKI and J. DOBRZYCKI. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 931–941.—Tests have shown that the presence of

[1] See *I.S.J.*, 1958, **60**, 210, 367.

$CaCO_3$ or muds during juice evaporation slows colour formation (and even reduces it in some cases) and inhibits scale formation. No difficulties have been encountered in filtration of the syrup of 55–60°Bx and the system has been patented.

* * *

Contribution to the Theory of Continuous Vacuum Pans. J. DOBRZYCKI. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 942–957.—In connexion with research on continuous pan design, a mathematical study is made of the problems of massecuite flow in a multi-cell pan. The amount of crystals discharged from a pan is expressed by

$$\frac{dz}{dt} = \frac{1}{(n-1)\,!}\, s\,(kt)^{n-1}\, e^{-kt}$$

where t is the time from the moment of nucleation to discharge, n is the number of pan cells, k is a coefficient of flow of the massecuite, and s is the number of crystal nuclei formed per unit time or introduced into the last cell. Integration of the expression enables the amount and weight of crystal mixture from the nth cell to be calculated. Formulae are also developed for the relationship between the distribution of crystal sizes and the number of pan cells.

* * *

Crystallization of Low-Grade Massecuite. P. M. SILIN. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 975–997.—The dependence of molasses exhaustion on the nature and quantity of non-sugars present and on viscosity is discussed, and melassigenic coefficients (kilos of sugar lost to final molasses per kilo of non-sugar) tabulated for a number of non-sugars, including glutamic acid, tyrosine, lactic acid, and various Na, K and Ca salts. The coefficent for betaine is given as 1·03 and that of invert sugar as 0·19. Nitrogenous substances have only a slight binding effect on sugar, and K salts have little melassigenic effect although they increase the molasses viscosity considerably. Values of the ratio of massecuite viscosity to molasses viscosity are given for different crystal contents. At a crystal content of 42% the massecuite viscosity increases sharply. Massecuite final Brix and purities are tabulated for different crystal contents (40–46%) and temperatures (30°–60°C) and for molasses purities of 54–66. The possibility of establishing optimal conditions is discussed.

* * *

Increasing Sugar Yield. A. MIRCEV. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 998–1009.—To facilitate a low-grade strike after heavy boiling, water is added to the pan up to three-quarters of that required, the remainder being added before the centrifugals. The amount of water required is calculated from the ratio of non-sugars to water for saturated molasses at 40°C. This ratio is about 2·5:1 for optimal supersaturation and optimal crystallization, especially at lower temperatures. The advantages of this system of heavy boiling are : easier dropping, quicker steaming-out, quicker crystallizing, better curing and less molasses. A "cold" exhaustion scheme for green molasses is described[1], where 15 tons of massecuite of 91·5 purity is boiled on thick juice and green syrup, and ripened for 10–12 hours in the crystallizers, two 20-ton doses of hot green syrup being added. From this is obtained 17 tons of raw sugar of 95·4 Rds (refractometric Brix). Black syrup of 76·8 purity is used for boiling low-grade massecuites. From one such boiling was obtained a sugar of 89·9 Rds and molasses of 58·0 purity.

* * *

Molasses Exhaustion. A. MIRCEV. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 1010–1023.—The relationship between saturation coefficient, purity and the non-sugars: water ratio is discussed. The "normal molasses" criteria proposed for the U.S.S.R. by P. M. SILIN are a Brix of 83·5° and viscosity of 44 poises at 40°C; the Sugar Research Institute proposes that the Brix criterion for "normal molasses" in Czechoslovakia should be 84·5°. Such a density corresponds roughly to a dilution to give a non-sugars: water ratio of about 2·2:1.

* * *

Development of the Beet Sugar Industry in Recent Years. R. KARGL. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 1037–1048.—Beet sugar factories erected during the past few years (before 1955) and their capacities are tabulated and discussed and future projects reviewed. The numbers and types of factories in 1931 and 1954 are compared and the latest technological processes and apparatus for qualitative evaluation of beet are reviewed. Automatic control and mechanization has led to a two-thirds cut in labour with a 20% increase in production.

* * *

Clarification of Flume and Wash Waters in the Sugar Industry using Hydrocyclones. J. HOLLÓ, J. TÓTH and A. BLUM. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 1051–1063.—Turbid factory waste waters were treated in hydrocyclones using 1 and 2 atm feed pressure and diameters of 77, 53 and 28 mm. Particle sizes ranged from below 50μ to over 700μ, and insolubles content was 2, 10, 20 and 30 g dry solids per litre. Satisfactory results were obtained, with up to 97% solids removal and mud concentration of 140 times.

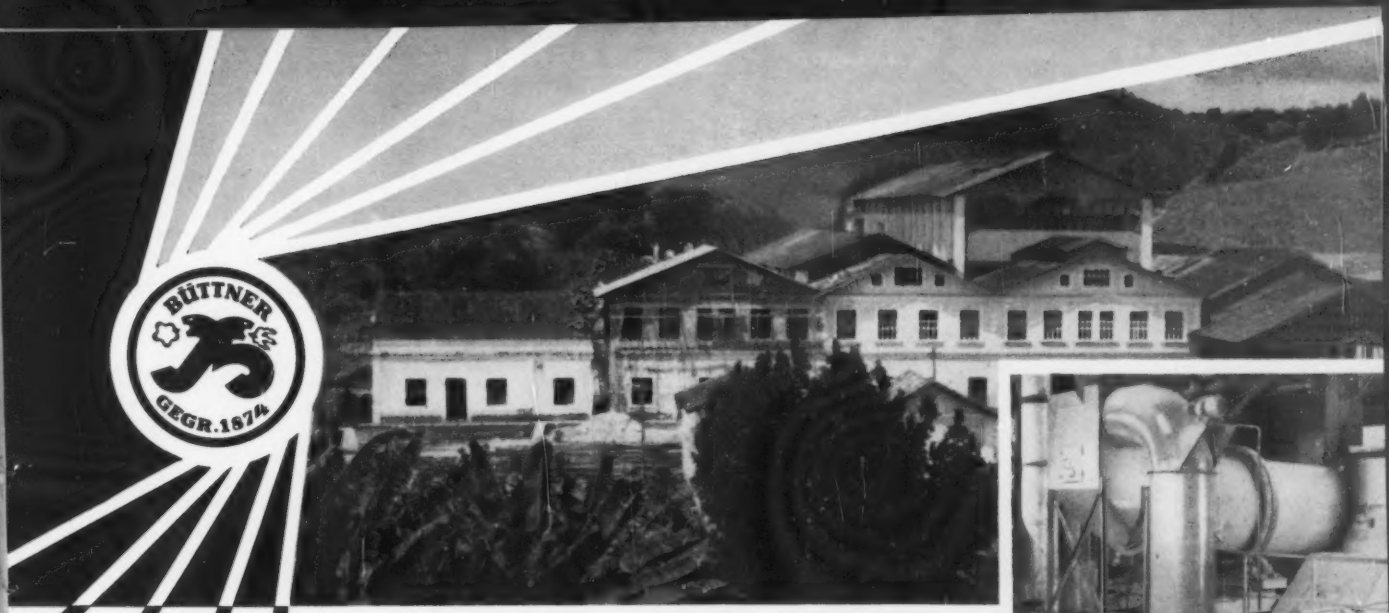
* * *

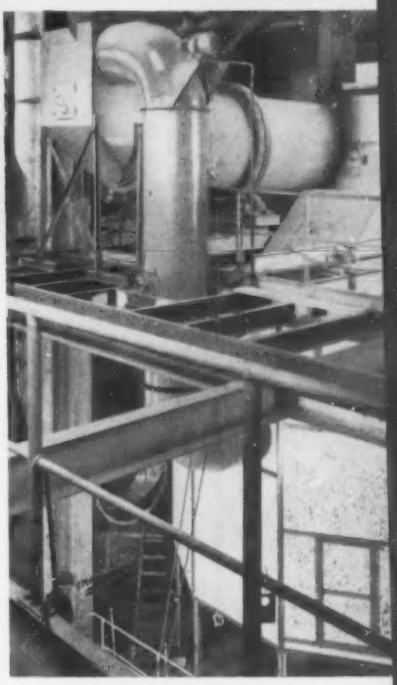
Factory and Waste Water in the Sugar Industry. J. VOTAVA. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 1064–1072.—The purification of diffusion and pulp press water is discussed. In biologically purified water in storage ponds, carp have been bred during the off-season, with a production of 550 kg fish per hectare of pond surface.

* * *

Variation in the Purity of Normal Molasses during Production. L. S. TVERDOKHLEBOV and O. S. CHIBISOVA. *Sakhar. Prom.*, 1958, (9), 4–9.—"Normal molasses", as defined by P. M. SILIN, is that which

[1] Cf. *I.S.J.*, 1959, **61**, 115.





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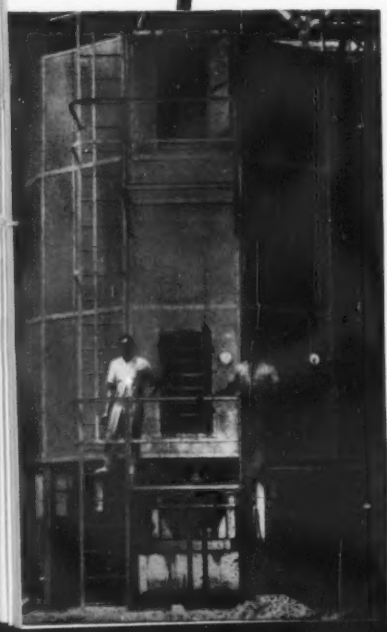

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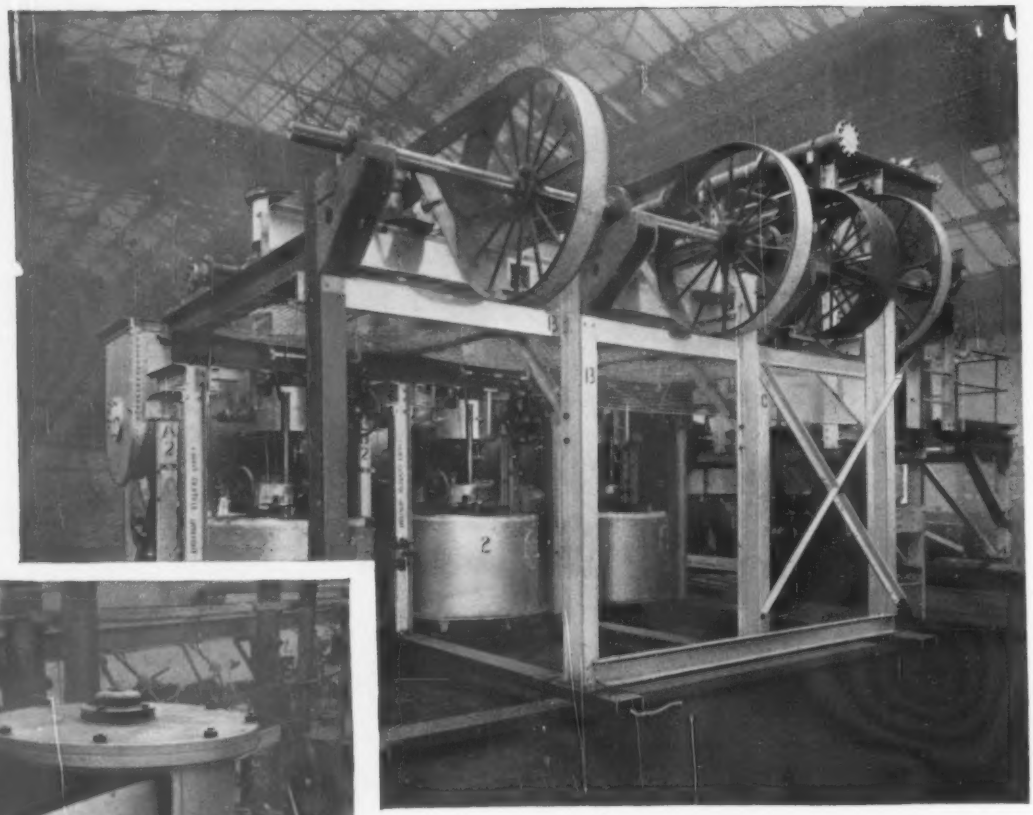

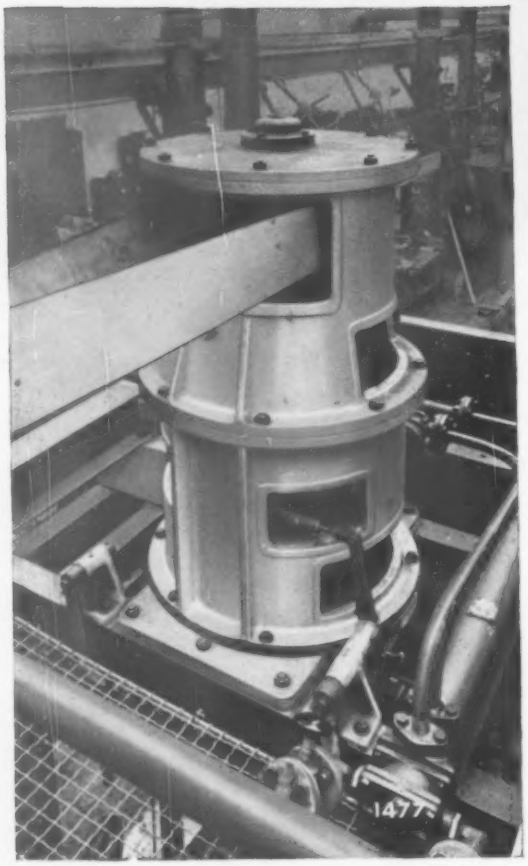

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has reached saturation at 40°C and 83·5% dry solids (the standard conditions adopted in the Russian factories). Tables are given of monthly molasses purities for nine factories in the Poltava group, each being the average over 5 campaigns (1952/53 to 1956/57). Considerable variations occur from factory to factory and month to month, especially in the second half of the campaign. The main factors influencing molasses purity are : the amount of dextrorotatory and reducing substances in the beet processed (which depends on beet quality); soil and climatic conditions; harvesting and storage.

* * *

Additional Crystallization of 1st Product Massecuite in Crystallizers. L. E. FLEISHMAN and N. YA. ARTEMOVA. *Sakhar. Prom.*, 1959, (9), 10–11.—In preliminary tests, 1st product massecuite was cooled in crystallizers from 77° to 60–65°C, during 2–4 hours. Results were satisfactory, a decrease in final molasses purity being obtained. However, an editorial note points out that the results are only approximate, since certain important factors were ignored, including massecuite viscosity, presence of fines, difficulties in spinning, and the sugar quality obtained.

* * *

Operation of Vacuum Filtration Equipment. V. A. ZAMBROVSKII. *Sakhar. Prom.*, 1959, (9), 12–16.—A number of difficulties have been experienced in the operation of Chugunov clarifiers and multi-cell vacuum filters. The defects and their remedies are discussed in detail; they include difficulties in removal of juice and muds from the clarifier, entrainment of juice into the condenser water, retention of juice in the filter cake, and inadequate sweetening-off and cake removal. The importance of data such as optimal temperature, filtration rate, correct preparation of 1st carbonatation juice, etc., as a guide for the operator is stressed. Predefecation, especially with return of part of the unfiltered 1st carbonatation juice, is considered an important factor in easy clarification and filtration. The optimal alkalinity of clarified juice is given as 0·06–0·08% CaO. Adequate control of first carbonatation juice quality is urged.

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Defecator Calculations B. I. KATS. *Sakhar. Prom.*, 1958, (9), 17–18.—The calculation of defecator dimensions is discussed, for systems where first carbonatation juice is returned, on a basis of retention time. Pertinent information from various Russian publications is quoted, but the absence of any clear and definite indications in the literature is deplored. A purely mathematical approach to the subject is considered inadequate, and the need for a sound basic physico-chemical theoretical treatment is emphasized.

* * *

A New Technique in Storage Tank Production. G. V. RAEVSKII. *Sakhar. Prom.*, 1958, (9), 18–20.—Originally intended for the petroleum industry, the tanks described are transported to site in a rolled-up form, a 5000 cu. m. tank forming a cylinder12 m long by 2·8 m diameter, and weighing 40 tons. On site, the floor is first unrolled and laid. The tank wall is then raised vertically by block and pulley on the centre of the floor; it is then unwound by means of a tractor or truck and the vertical edges then welded together. The wall and floor are then welded together and the top of the tank placed in position by a light crane. Two or three of these tanks are being erected for molasses storage at each new factory in the U.S.S.R.

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New Evaporators. N. YU. TOBILEVICH and V. N. SHCHEGOLEV. *Sakhar. Prom.*, 1958, (9), 34–39.—The design of a new evaporator body is described and illustrated. The unit, based on the "VTS" system of the Central Research Institute, has roof-form tube plates with slopes of 1:20 towards the outer wall, two external downtakes and an external catchall. When used for a first effect the unit has a removable bottom which slopes outwards; as the remaining effects, it will have a dished bottom. A single central vapour feed is incorporated, and heating surface is calculated as a possible 1200 sq.m. at 2·8 m diameter or 2100 sq. m. for a 3·34 m diameter. The design is based on investigations into the hydrodynamics and heat transfer during juice evaporation. A 35-day trial of a 1200 sq. m. evaporator gave satisfactory results. The metal required to build a unit is 20–30% lower than for other evaporator designs.

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Optimal Scheme for Weighing Final Molasses. YU. M. POLYAKOV. *Sakhar. Prom.*, 1958, (9), 49–50.—At Krasnoyarsk factory two 1-ton molasses scales were replaced by a 5-ton scale, and a tank was installed on the pan floor for receiving molasses from the tank below the centrifugals during the discharging of a batch from the scale. The receiving tank discharges to the scale, returning excess molasses to the tank below the centrifugals. Spillage of molasses is prevented and disposal to the main molasses storage tank is accelerated.

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Waste Water Purification by Fermentation in Ponds and Field Irrigation. T. PIETRZYKOWSKI and S. GODWOD. *Gaz. Cukr.*, 1958, **60,** 269–276.—In Poland waste water is purified by pond fermentation and field irrigation. In E. NOLTE'S scheme, 3 ponds are used, two for fermentation and the third for liming with milk of lime and settling. Water from the last pond is sprayed over a field which acts both as a mechanical and biological filter. The humic and almic acids formed check development of anaerobes. Drainage techniques and the suitability of various soil types are discussed.

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Automatic Temperature Control. T. JAWOROWSKI. *Gaz. Cukr.*, 1958, **60,** 280–284.—Automatic control of raw juice temperature leaving the heaters before the first filters and before 2nd carbonatation was introduced at Chelmza factory in 1957. Platinum resistance thermometers are used in conjunction with electrical regulators and indicators for control of steam and

vapour supply. Full details are given, with illustrations of the temperature charts produced. Regulation is to within ± 1·5°C, compared with fluctuations of 18°C at the heaters before the 1st filters and 10°C at the heaters before 2nd carbonatation using manual control. The advantages of the system are discussed.

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Affination of 2nd and 3rd Product Sugars. J. KRZETOWSKI. *Gaz. Cukr.*, 1958, **60**, 284–285.—In reply to previous articles on the subject[1], the author mentions four methods tested in Poland and elsewhere. The advantages and disadvantages af each method are discussed. The purification of 2nd product sugar by normal curing and melting with filter washes to about 70°Bx before adding to diffusion juice has been found to give satisfactory results. The colour of the sugar produced has been of the order of 0·3–0·4°St in certain Polish factories.

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Principles of Evaporator Station Automatic Control. S. ZAGRODZKI. *Zucker*, 1958, **11**, 455–459.—See *I.S.J.*, 1959, **61**, 22.

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Recent Results with the D.d.S. Diffuser. H. BRÜNICHE-OLSEN. *Socker Handl.* II, 1958, **14**, 99–103.—Development of the D.d.S. diffuser led to improved performance during the period 1954–1956 and this has been maintained during 1957. A new unit had losses of 0·16% on beet with a draught of 109% in the latter half of the 1957 campaign. One factor has been the attempt to obtain ideal transport conditions in the trough; this has been advanced by the use of coarse cossettes produced by new slicers, although addition of anti-foam oil permits the use of fine cossettes as it facilitates the separation of air bubbles and consequently increases permeability. Bacteriological conditions in the diffuser depend on the temperature and retention time; at Assens, where throughput is great, retention time is small and the temperature is 74°C so that only 5 kg formaldehyde is required per 1000 tons of beet. Press water produced is very pure and only needs screening, heating to 70–80°C and neutralizing before returning to diffusion; this is attributed to the rapid heating in the D.d.S. diffuser which is equivalent to a scalding process, and is supported by a conductimetric examination of the plasmolysis of cossettes. Fitting a partition across the lower end of the trough has prevented admission of air; the colour of the pulp has been reduced accordingly. In comparisons between juice produced in trough and battery diffusers run in parallel, it has been found that the former had a pH 0·1 units lower but gave a first carbonatation juice of higher effective alkalinity, and also contained 20% less invert sugar. A comparison is made between the European and U.S.A. versions of the diffuser, the latter built by the Silver Engineering Works Inc.

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Juice Purification at the Örtofta Factory in 1957. T. ULFHEDEN. *Socker Handl.* II, 1958, **14**, 105–112.—The development of juice purification techniques at Örtofta factory is briefly discussed. The current process is to heat limed juice with pan vapours to 50°C, mix with overflow from the Oliver filter and then mix with "sludge soup" from the Dorr thickener, over-limed juice and fresh water. It is heated to 72°, followed by main defecation at 75° and first carbonatation. Some of the "sludge soup" from the Dorr thickener is returned to the limed juice while the rest goes to the Oliver filter. The clear overflow passes to a preheater to bring it to 98°C, it is filtered and carbonatated to 0·07% CaO and refiltered. The thin juice is heated from 88 to 95°, sulphited and refiltered. Thin juice quality and lime salts and thick juice colour are tabulated and the effectiveness of the process discussed. A test devised for raw juice quality is to lime for 10 minutes to an alkalinity of 1·8 and then carbonatate to various alkalinities at 72°C. The colour of samples is determined and drawn in the form of a graph; a series obtained during a number of weeks is illustrated. An investigation of colour and turbidity by washing B-sugars and analysis of juices showed that the colour was on the outside of the crystal while the turbidity was uniformly distributed. Sulphitation lowers the colour from 636 to 504 units and evaporation increases it to 584. Turbidity increased from 17 units to 29 on sulphitation and to 165 after evaporation. Tests showed that filtration can reduce turbidity to one fifth, and the material to be treated, method, and type of filter are discussed.

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Determination of the Retention Time of the Sludge Phase and the Liquid in Thickeners by means of Radioactive Tracers. S. WRAMSTEDT. *Socker Handl.* II, 1958, **14**, 113–120.—By labelling the liquid and solid phases of first carbonatation juice with ^{24}Na and ^{140}La, respectively, the retention time of the latter, measured by radioactivity counts, was approximately 20 minutes with adequate separation of "sludge soup". Retention time of the liquid phase was measured from the volume of the thickener. In one Dorr thickener, of large (9·5 m) diameter, mean clear juice retention time was 85 minutes, and there was considerable mixing, while in another type of Dorr thickener, of 5 m diameter, mean retention time was 40 minutes and far less mixing could be observed.

* * *

Chemical Cleaning of Evaporators. I. Practical Experience with Boiling out of Evaporators with Caustic Soda Solutions. A. KELLER, R. KELLER and H. G. RAVE. *Zucker*, 1958, **11**, 476–478.—It has been found that, whereas formerly the main constituent of evaporator scale was the easily soluble calcium carbonate, nowadays much of the scale is calcium oxalate, not easily soluble in HCl, with greater or smaller amounts of silicates, aluminium and iron oxides, and organic substances. Examination of the scale from a number of factories during the 1957–58 campaign showed that where the juices were treated with basic ion exchangers, the scale had a very low calcium oxalate content, although most of the juices had not been

[1] *I.S.J.*, 1957, **59**, 316; 1958, **60**, 204.

treated thus and the corresponding scale had a very high calcium oxalate content. Results of tests on boiling out with 3·75–10% NaOH solutions for 4–17 hours made at a number of factories showed that where there was a thick deposit with high calcium oxalate content, one boiling-out was not enough to convert the oxalate to carbonate in sufficient quantity. The effect of the NaOH concentration on the conversion to carbonate could not be determined. Whether two or three boilings will give satisfactory results where one is inadequate remains to be determined, and a further report is to be published on investigations in this connexion.

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Economical Lime Production in the Coke-Fired Shaft Kiln. F. HOFFMANN. *Zucker*, 1958, **11**, 478–482.—The thermochemical and thermo-physical fundamentals of lime production are used as a basis for considering the economics. The CO content of waste gas can be reduced by reducing the gas temperature to 900°C as soon as the oxygen content falls to 1·5–2%. Suppressing the de-oxidation zone in this way can be done by feeding small particle limestone and coke, uniform charging and discharging and ensuring good insulation of the kiln.[1]

* * *

Beet Storage. M. S. CHELEMSKIJ, K. SANDERA, M. DRACHOVSKÁ, Z. SRZEDNICKI and H. D. WALLENSTEIN. *Zeitsch. Zuckerind.*, 1958, **83**, 494–498.—The problems of beet storage in the U.S.S.R., Czechoslovakia, Poland and East Germany are discussed.

* * *

Filtration of Carbonatation Juice. R. KOHN, J. VASÁTKO and Z. KOHNOVÁ. *Listy Cukr.*, 1958, **74**, 221–228.—Laboratory tests were made to determine the effect of colloids in carbonatation juice on its filtration, using a Dedek-Ivancenko micro-filter, with a layer of pure $CaCO_3$ particles. The determinations were made at 20°C and vacuum of 400 mm Hg. Specific viscosity of diffusion and carbonatation juice was shown to have no effect on filtration. Two beet pectin solutions were tested; filtration of the first was difficult, while in the second, the low-methoxylated pectin did not filter out owing to reaction between the Ca^{2+} ions with the ionized carboxyl groups of the pectin. Small amounts of calcium ions from the calcium pectate were adsorbed by the $CaCO_3$, producing an impenetrable film of insoluble pectate across it. For the carbonatation juice filtration tests the pure $CaCO_3$ layer was used as well as one prepared from first carbonatation mud. The juices contained varying amounts of colloids but it was found that filtration time was only 5% higher for those with higher colloid content, this being due to adsorption of the colloid particles on the $CaCO_3$; this is not considered to be significant. Juice from deteriorated beet did not filter easily. The relationship between the colloid content of diffusion juice (especially pectins) and the filtration coefficient of muddy first carbonatation juice is discussed with the aid of a graph. It is concluded that the colloid content of the juice has no effect on muddy 1st carbonatation juice filtrability and that the main cause of filtration difficulties is to be found in the type of particles in the muds, and their composition.

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Economics of Sugar Factory Machinery. I. Lifting Beet to the Beet Washer. II. Rotary or Piston Vacuum and Gas Pumps. O. BÖHM. *Listy Cukr.*, 1958, **74**, 229–232; 257–259.

(I) Choice of lifting gear depends on individual conditions. To raise beet only, beet wheels are best, but if flume water is to be raised too, a combined beet and water wheel is recommended for heights up to 7·5 m, and a beet pump for heights greater than this. Energy requirements and costs are discussed.

(II) Under present conditions the piston vacuum pump is considered most economical of the rotary and piston vacuum and gas pumps studied. Electric gas pump drive is preferred to steam, while belt and gear drives are suitable for both gas and vacuum pumps.

* * *

Determination of the Relationship between Specific Gravity and Beet Digestion. J. HROMÁDKO and L. SCHMIDT. *Listy Cukr.*, 1958, **74**, 234.—From tests carried out at the Sugar Research Institute no linear relationship between the sugar expressed from beets and the specific gravity of the beets could be found.

* * *

Heat Problems in the Sugar Industry. W. VON PROSKOWETZ. *Zucker*, 1958, **11**, 498–508.—See *I.S.J.*, 1958, **60**, 331.

* * *

Vacuum Treatment of Beet Cossettes during Diffusion Juice Extraction. N. A. BURENKOV. *Sakhar. Prom.*, 1958, (10), 7–9.—Subjecting cossettes to vacuum before diffusion to destroy the layers of air on the cells and in the intercellular spaces, and thus provide a larger contact surface for diffusion liquor, is suggested as a means of increasing sugar extraction and extraction rate. In laboratory tests, cossettes, subjected to a vacuum of 520–540 mm Hg for 1–3 minutes, yielded a juice of higher Brix on digestion, the average densities of juices from untreated and treated cossettes (18 samples) being 10·18°Bx and 10·57°Bx, respectively. In pilot-plant diffusion tests, the average increase was 0·98°Bx, from 6·55 to 7·53°Bx, using a vacuum of 560–570 mm Hg.

* * *

Yellow Sugar Removal. N. K. KANIBOLOTSKII and E. B. BAL'TSER. *Sakhar. Prom.*, 1958, (10), 35–36.—It is suggested that the factories of the Voronezh district could increase their capacity by 2·5—8% during the beet campaign by removal of 25–80% of the yellow sugar produced (affined 3rd product or 2nd product, of at least 95–96 purity) and either sending it to other branches of the food industry or storing it for refining after the campaign.

[1] See also *I.S.J.*, 1958, **60**, 333.

New Books and Bulletins

Colorimetric Chemical Analytical Methods. 5th Edn. 360 pp ; 7¼×9¾ in. (The Tintometer Ltd., Waterloo Rd., Salisbury, Wilts.) 1959. Price: 30s. 0d.

This new edition has been completely rewritten and enlarged, and is in the form of loose leaves held in a stiff ring-binder. It is divided into seven sections, each with a colour-coded tab. The types of Lovibond equipment are described and illustrated in the first, with a sheet showing the range of glass colour standards in the three colours—red, yellow and blue. The second part deals with the determination of pH of aqueous solutions, with special treatment of blood, soil, etc. In the third part appear methods of analysis of inorganic materials, from aluminium to vanadium, in some cases giving 2, 3 or 4 methods. Of the organic materials covered by Part 4, carbohydrates and sugar are two analyses described which will be of most interest to our readers. Part 5 concerns analyses of medical interest. Part 6 refere to noxious vapours, and Part 7 to colour grading of beer, benzole, etc., and quality grading of carbon, coal tar products, etc.

Each test is introduced and the principle of the method involved is explained. The reagents required are described together with the Comparator discs to be used, and the techniqes given in detail. Comments on the method, material used, inferences, etc., are recorded as "Notes", and references are given to the literature on which the method is based. Besides a list of contents, the book is provided with an index of tests, and also an index of applications, which enhance its value to the user.

* * *

British Instruments—Directory and Buyers' Guide. 322 pp; 8¼×11 in. (Scientific Instrument Manufacturers' Association and United Science Press Ltd., 9 Gough Square, Fleet Street, London E.C.4.) 1959. Price: 42s. 0d.

For anyone requiring a source book for the name of British manufacturers of scientific instruments, this directory will be invaluable, since it is produced by the S.I.M.A. and has the co-operation of other associations allied to the instrument industry. It includes a list of specifications directly bearing on instrument matters issued by the British Standards Institution, and also a list of consultants, engineers and installers of instrumentation schemes. Firms manufacturing single or small batches of instruments to a client's order are also given, while a large section gives manufacturers listed under a classified index of products, provided with a glossary of headings used in English, French, German and Spanish. The companies concerned are then listed, with overseas agents where they are appointed, and another section lists trade names. A series of reference sheets describes the products of manufacturers, while a further section of display advertisements follows, both these sections having indexes.

* * *

Pioneer Sugar Mills (Pty.) Ltd. 1884–1958. 24 pp; 8¼×10¾ in. (Pioneer Sugar Mills (Pty.) Ltd., Pioneer Estate, Via Townsville, Queensland, Australia.) 1958.

Drysdale Brothers and Company was a partnership formed in 1882 to acquire lands in the then undeveloped country of the Lower Burdek in delta and to set up the machinery for Pioneer mill and, in spite of a series of difficulties, made successful progress, building a second mill at Inkerman in 1914, when the Company adopted its present name. The 1958 season is the 75th anniversary of its successful entry into the sugar industry of Queensland and an attractively illustrated brochure has been produced to mark the anniversary.

The various aspects of the Company's history and present-day activities are described, with considerable attention to the importance of irrigation in cane production, cane transport, raw sugar production, the development of both mills, and sugar transport to the port, as well as a note on other activities of the company, staff housing and amenities and officers and executives of the company.

* * *

El Convenio Internacional del Azúcar 1954 a 1959. (The International Sugar Agreement 1954–1959.) L. MARINO PÉREZ. 32 pp; 6×9¼ in. (L. Marino Pérez, Edif. Blanco 807, Belascoain 452, Havana, Cuba.) 1959.

The history of the post-war International Sugar Agreement is briefly discussed with the object of examining its achievements in relation to its objects. This is done by examination of statistics of production, consumption, stocks, quotas and their fluctuations, exports and imports on the free market, and the price of sugar. It is concluded that, while the Agreement cannot have completely effective control while countries producing appreciable quantities of sugar remain outside, it has had a real stabilizing effect on the sugar market and so avoided the exaggerated swings which would have been caused had it not been in existence. The setting of quotas and mechanism for redistribution has not been satisfactory, but this is very difficult, and the redistributions have been able to correct certain of the quotas which were set at incorrect levels for reasons of prestige, etc. The effect of the Agreement on the Cuban industry is discussed and it is also concluded that a low price for sugar affects Cuba particularly badly because of the marketing and importing policies of other countries.

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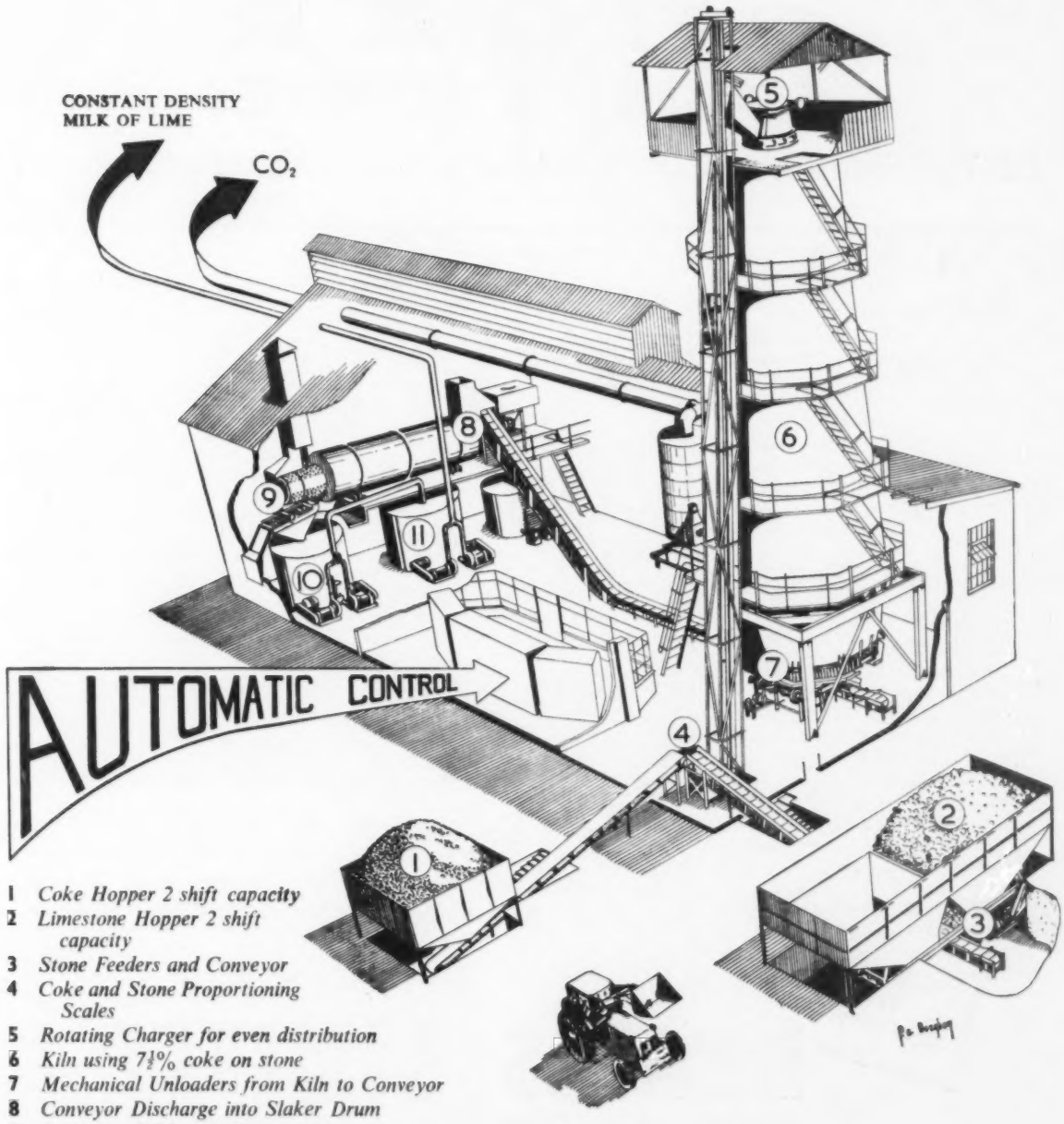

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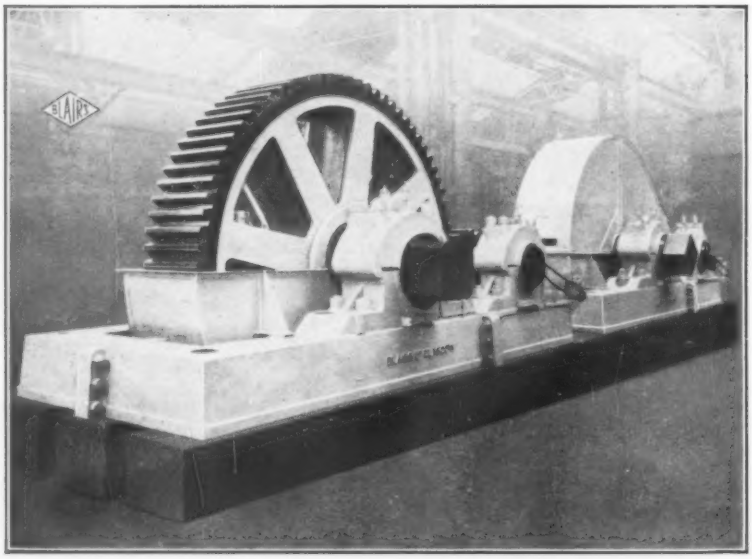

This illustration shows the second motion gearing for driving Sugar Cane Crushing Mills. These Cast Steel Spur Wheels and Pinions are carried on Mild Steel Shafts, supported on Gunmetal-bushed Cast Iron Bearing Blocks. The Gears are fitted with oil-tight and dust-proof covers.

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Determination of Small Quantities of Sugars in Aqueous Solutions. (Application to Sugar Factory Return Waters). A. LEMAITRE. *Sucr. Franç.*, 1958, **99,** 250–251.—The various colour reactions of sucrose which might be used as a basis for its determination are surveyed and the preferred method described in detail. In this, 2 ml of the sugar solution is mixed with 0·05 ml of 80% aqueous phenol solution and 5 ml of concentrated sulphuric acid added within 20 seconds. After mixing, standing for 10 min, and cooling to 25 C in 10 min, the colour absorption is measured at 490 mμ. Sensitivity is 5 mg/litre and the colour absorption is directly proportional to sugar concentration.

* * *

Use of the Flame Photometer to Determine Lime Salts in Flowing Second Carbonatation Juice. H. ZAORSKA. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 869–879.—While the sugars and non-sugars content of juice and its viscosity will affect measurement of the lime salts content using a flame photometer, tests have shown that a variation from 0·02 to 0·10% NaCl or from 0·1% to 0·3% KCl caused no change in the Ca content indicated. The sugar content of 2nd carbonatation juice does not vary greatly, so that the error in lime salts determination is no greater than 1 mg CaO per 100 ml juice. The use of the flame photometer in conjunction with a pH meter for continuous control of 2nd carbonatation is discussed[1].

* * *

Results of 35 Years of Sugar Factory Control. P. PAVLAS. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 880–900.—Five graphs and three tables of data from beet and juice analyses over the period 1920-1955 are given and discussed.

* * *

Polarographic and Polarimetric (Potentiometric) Determination of Lime in Sugar Juices using "Complexon" (EDTA). K. CIZ and V. VALTER. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 901–916.—In the method of BURIÁNEK & DURDÍK[2], in which the amount of Zn displaced by Ca from the Zn salt of EDTA in an ammonia buffer solution is determined polarographically, it has been found that the Zn is almost quantitatively displaced by Mg as well as Mn and Cu when these are present. Fe and Al have no effect. The method is therefore only suitable for determination of total hardness. A potentiometric method has been proposed by PRIBIL & VICENOVÁ for all intermediate beet factory products in which the sample is titrated with 0·01M disodium EDTA, a change in conductivity occurring when all the Ca has been chelated and the EDTA starts to combine with the Zn. No interference is found with Mg, Cu, Fe, Al or Mn. Analyses of syrup have shown that the polarographic method gives high results compared with the oxalate and potentiometric methods, but that deformation of the polarographic curve with lower purity products or high colloid content can give low indicated results.

* * *

The Theory of Similarity of Properties of Sugar Solutions. J. BURIÁNEK. *Sborník Cukrovarnicko-Reparske* 1955 *Konf. v Praze*, 1957, (2), 958–971.—It is shown that analogies exist in the relationship between different properties of sugar solutions and their concentrations. These analogies are combined in a "theory of similarities" in which two properties A and B are considered "similar" if, at the same concentration, they satisfy the equation $A—A_1 = K(B—B_1)$, where A_1 and B_1 are the numerical values of the same properties in an infinitely diluted solution and K is a similarity constant. For sugar solutions, such properties include specific heat, heats of dilution, viscosity and enthalpy.

* * *

Pectic Substances in Diffusion Juice. VAN VEN'-SHEN. *Sakhar. Prom.*, 1958, (9), 21–27.—Quantatitive determination of the polygalacturonic acids in diffusion juice was made by adding aluminium chloride or potash alum to the acidified juice at pH 4·4 and 40°C, collecting the precipitated aluminium pectate and measuring the amount of CO_2 liberated when this is heated with 19% aqueous HCl in an oil bath. The apparatus used is described in detail. Tests were also made to determine the effect of pH, temperature and retention time during diffusion on the peptization of pectins. The pH at which the minimum amount of pectins entered the juice was found to be 5, an increase to pH 7 increasing the amount of pectins by almost 10 times. Under alkaline conditions the rate of peptization rapidly increases, although the pectins, which have an acid reaction, tend to lower the pH. A marked increase in peptization was found at temperatures higher than 80°C and with longer extraction periods.

* * *

Determination of Thin Juice Hardness with Ethylene Diamine Tetra-Acetic Acid. C. REICHEL. *Zucker*, 1958, **11,** 475–476.—The determination of thin juice hardness with EDTA is further discussed[3]. With the discovery that triethanolamine prevents interference

[1] Cf. *I.S.J.*, 1959, **61**, 118.
[2] *I.S.J.*, 1955, **57**, 202.
[3] See *I.S.J.*, 1953, **55**, 285.

by aluminium, the titration is now unhindered, with a clear end-point. The analysis is carried out as follows: 10 ml of a buffer solution (54 g of NH_4Cl, 350 ml conc. NH_3 solution, 2 g Mg complex of EDTA and 5 g sodium sulphide, made up to 1 litre) is added to 50 ml of thin juice and 2 ml of "Eriochrome Blue-black" in methanol is added and the titrating solution added until the colour changes to green; if no clear change is apparent, the process is repeated, but with 5–10 ml triethanolamine added before the indicator. The titration solution is an aqueous solution of 3·317 g disodium salt of EDTA made up to 1 litre, and 1 ml is equivalent to 0·5 mg CaO and corresponds to 1° German hardness. For thick juice hardness determination, 10 ml is diluted to 100 ml with water and then titrated.

* * *

The Effect of Temperature on the Determination of the Filtration Coefficient F_K. R. OSVALD. *Listy Cukr.*, 1958, **74,** 223–234.—In laboratory tests to determine the effect of temperature on the value of F_K it was found that the value for 1st carbonatation juice at 50°C was twice that at 80°C. Five different samples were filtered at 50, 60, 70 and 80°C and a graph drawn of the results; the optimal temperature was found to be 65°C (the slope between 60 and 70°C is very slight, however). At 80°C vapour in the pipette makes the determination difficult.

* * *

Sugar Solutions: Moist Air Equilibria. P. DEVILLERS. *Sucr. Franc.*, 1958, **99,** 287–290.—A formula governing absorption of atmospheric moisture or drying of pure and impure sucrose syrups is developed and used, with boiling point elevation data from the literature, to calculate equilibrium R.H. values corresponding to various purities and Brixes.

* * *

Estimation of Calcium in Technical Sugar Solutions using Ethylene Diamine Tetra Acetic Acid. N. A. RAMAIAH, -.VISHNU and R. K. CHATURVEDI. *Sharkara*, 1958, **1,** 124–136.—Two methods have been developed; in the first, the solution, diluted to 5–15°Bx and clarified with Horne's dry lead, is treated with powdered potassium ferrocyanide to remove excess lead and other interfering cations. Aliquots are then treated with a fixed amount of $CuSO_4$ and ammonia so that it becomes 2M with respect to the latter, and then increasing amounts of EDTA solution are added and the solutions made up to 25 ml. Measurement of the optical density at 630 mμ *vs.* EDTA added gives a graph comprising three lines, with a slope from the horizontal at the end-point (Ca) and a return to the horizontal at the point where the Cu is all chelated. In the second method the ferrocyanide treated solution is titrated with EDTA solution using murexide indicator as has been previously described in the literature.

* * *

Behaviour of Saturated Sucrose Solutions in the Presence of Aminoacids. S. FUMASONI and M. LAURETTI. *Ind. Sacc. Ital.*, 1958, **51,** 197–200.—Solubility of sucrose at 25°C and 45°C is not appreciably altered by the presence of up to 1·268 g/20ml of glycine or 0·115% of tyrosine; on the other hand, the presence of sucrose increases the solubility of tyrosine by 21% (20% sucrose), 23·3% (30% sucrose) and 30·8% (40% sucrose).

* * *

Conditions Affecting the Quality of Clarified Liquors. II. J. MLCHOVÁ. *Listy Cukr.*, 1958, **74,** 255–256.—The tests previously described[1] have been extended, the heating time being lengthened. Affined sugar was dissolved in distilled and condenser water, thin juice and aqueous solutions of $CaCO_3$, $MgO,MgCO_3$ and ferrous ammonium sulphate and, after subjecting to a temperature of 96°C for 6 hr and 20°C for 10 hr, the solutions were filtered and the colour, ash, alkalinity to phenolphthalein end-point, and pH determined. In all cases the colour increased with the heating, while the pH, and alkalinity fell. Conductivity tended to fluctuate. Full details are tabulated. The use of MgO as an alkali is discussed.

* * *

Sucrose Sodium Acetate, A New Sugar Compound: Sodium Saccharate. T. MÁNDY and G. VAVRINECZ. *Zucker*, 1958, **11,** 545–548.—Physical data, including crystallographic data, are given of a sucrose: sodium acetate double compound isolated by slow evaporation at room temperature of a solution saturated with sucrose and sodium acetate. The crystals are non-hygroscopic and melt at 116°C to a colourless liquid which on further heating changes to yellow and then to brown. The solution does not reduce copper solution. The formula is given as $NaC_2H_3O_2$, $C_{12}H_{22}O_{11}$. Its crystals are rhombic-bipyramidal and have the notation D^{13}_{2h}–Pnmm. Data are also given for sodium saccharate crystals[2].

* * *

Refined Test Techniques for Polarizing Raw Sugar. E. J. CULP and H. E. SOMMER. *Amer. Chem. Soc.*, 134*th Meeting*, September 1958, *Abstr. of Papers*, p. 21 D; through *S.I.A.*, 1958, **20,** Abs. 815.—The effects of three procedures on the polarization of raw sugars was studied. The average pol of sugar samples measured at a controlled temperature of 20°C and a relative humidity of 50% was 0·03°*S* lower than when the pol was measured under uncontrolled conditions which do not minimize loss of moisture (~35°C, 35% R.H.). When sugar samples were defecated and then mixed with water to give a total volume of 90 ml, an increase of 30 ml compared with the conventional method, the pol was calculated as being 0·06°*S* lower. Ordinary raw sugar flasks were found to contain an average of 100 ml. Selection of flasks to conform to the limits 100 ± 0·01 ml has given an estimated decrease of pol readings of 0·03°*S*.

[1] *I.S.J.*, 1958, **60,** 339.
[2] See also *I.S.J.*, 1958, **60,** 372.

BY-PRODUCTS

Molasses Research in Hawaii. A. L. PALAFOX. *Sugar J.* (La.), 1958, **21,** (7), 31–33.—An account is given of recent research in feeding of low-grade sugar and molasses to chickens. Potassium has been found to be a primary cause of diarrhoea in chickens, so that de-ionization of the molasses fed has been found to reduce the water intake of the fowls and the moisture content of their droppings.

* * *

The Bagasse Paper Industry in Argentina. E. J. SCHLEH. *La Indust. Azuc.*, 1958, **64,** 525–550.—An account is given of the development of bagasse utilization for paper-making in Latin America, and the possibilities of establishing such an industry in Argentine are discussed. Achieving a surplus of bagasse is discussed, with reference to modernization of furnaces and boilers, use of fuel oil, etc.

* * *

Sugarcane Bagasse as a Fibrous Papermaking Material. S. B. KNAPP *et al. TAPPI*, 1957, **40,** 595–645.—A detailed survey is made of the constitution and structure of Hawaiian bagasse, the effect of depithing, and comparison of the Kraft, soda, neutral sulphite, bisulphite, modified alkaline, hydrotropic and Celdecor pulping processes, as well as the bleaching of pulps.

* * *

Ash or Silica and the Importance of its Elimination in the Manufacture of Chemical Cellulose from Sugar Cane Bagasse. A. K. WILHELM. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 271–275.—The insoluble silica present in bagasse presents the major problem in chemical production of cellulose and a process is described which minimises its effects. The bagasse is treated in a "Hydropulper" with cold water, and the fibres separated from the pith, epidermis and cuticle by screening and washing. The fibres may then pass on to the cooking pulper, etc.

* * *

Manufacture of Sorbitol from Sugar Cane. A. CASTILLO MUJICA. *Mem. XXXI Conf. Asoc. Técn. Azuc. Cuba*, 1957, 277–282.—Cane juice is limed and clarified, and bleached with SO_2 or calcium hypochlorite plus active carbon. It is evaporated to 50–55°Bx, cooled and treated with yeast to invert the sucrose present. When this is complete it is discharged to a mixer and a catalyst added (one part of finely divided nickel supported on four parts of an infusorial earth). It is transferred to a vertical reactor and a current of hydrogen bubbled through. A reaction pressure of 250 p.s.i. and a temperature of 137°C are maintained and within a few minutes give a 95% reduction of the glucose and fructose to sorbitol. When all is converted, the solution is filtered (and the catalyst re-activated), and passed through cation and anion exchange resins before passing to the pans to be concentrated to an 85% solution of sorbitol.

By-Products Research in Hawaii. ANON. *Rpt. Expt. Sta. Comm., H.S.P.A.*, 1958, 55–57.—Cane wax recovered from mill cleaner scums is purified by treatment with a light petroleum solution and activated carbon; this gives a white wax, m.p. 78°C, in 75–80% yield. The wax includes hydrocarbons, alcohols, esters and a ketonic fraction shown to be a keto-acid or ester, $C_{76}H_{150}O_3$, m.p. 77°C. Wax can be emulsified by sulphating and neutralizing 10% of the wax, blending with the molten 90% remainder, and adding this to the liquid phase with rapid agitation. Alternatively, one-third by weight of methyl stearate may be added to the wax before emulsifying. Feed trials are under way with ammoniated bagasse pith and urea, as well as mixtures containing molasses. Other investigations include composition boarding made from bagasse or bagasse pith and di-isocyanates; a surface-active agent made by reaction of sugar with toluene di-isocyanate; water or solvent soluble waxes from sugar and octadecyl isocyanate; and production of a pure white alpha-cellulose by removal of lignin and other solubles from bagasse with an acidified solution of sodium chlorite to give a white holocellulose which is then treated with 18% KOH solution to remove the hemi-cellulose leaving the alpha-cellulose (43% on bagasse).

* * *

Improvements in the Bybrook Distillery. P. S. SKINNER. *Jamaican Assoc. Sugar Tech. J.*, 1957, **20,** 50–52.—The improvements include the use of an electrically driven mechanical wash mixer which permits preparation of 4000 gallons/hr of wax instead of the previous 1300 gal/hr of imperfectly mixed wax obtained with a compressed air "ploughing" trough and cistern; installation of a wash preheater, and fitting a calandria in a pot still instead of 2 coils. Comparison of the modified still with an unconverted coil still showed better circulation, shorter distilling cycle and easier cleaning, which more than make up for the cost of the calandria which was double that of new coils.

* * *

New Developments in By-Products. A. R. RUÍZ. *Sugar J.* (La.), 1959, **22,** (8) 32-33.—A survey of plants in Cuba, started in 1958 or proposed, for production of bagasse board products and animal feeds containing sugar, yeast, molasses, etc.

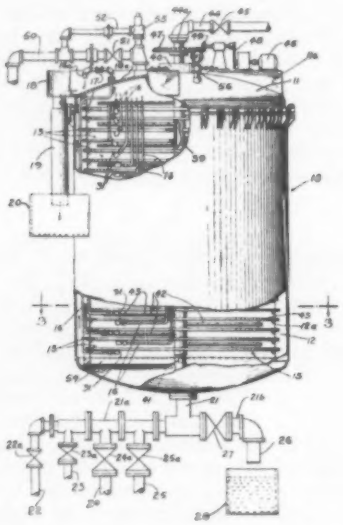
* * *

Francisco Sugar Company Processes Hardboard from Bagasse. ANON. *Sugar J.* (La.), 1959, **22,** (8), 34–36.—Central Francisco is to supply 75,000 tons per year of bagasse which is needed to provide raw material for a new hardboard plant adjacent to the sugar factory. The plant uses a process developed by the Taylor Corporation, and is described in some detail.

PATENTS

UNITED KINGDOM

Filters. FAS-FLO FILTER CORP., of New York, N.Y., U.S.A. **811,998.** 24th August 1955; 15th April 1959. The removable cover 11 of the leaf filter is held against the pressure housing 10 by a ring of bolts. Underneath it hang two vertical supports 12 which carry semi-circular filter leaves 13 in tiers with the ends of the diameters on the rods 12a carried by supports 12. The centres of the leaf arcs are supported on the comb or saw-tooth edges of vertical rods hung from 11, so that the leaves are horizontal. Draw-off pipes 16 are connected to the bottom of the leaves and run to the periphery, up and out of the cover through sealed joints, to discharge through spouts 16a by way of valves 17. They discharge into trough 18 which feeds a movable pipe 19 and so any one of the three chambers of trough 20. Pipes 16 from the



two tiers of leaves are arranged to occupy adjacent quadrants, leaving one side clear for easy removal of damaged leaves. Wash water supplied through pipe 44 and rotary connexion 44a feeds sluice pipe 39. This carries arms 42 with nozzles 43 and is supported by bearing 41. Water washes muds off the leaves as the pipe 39 revolves under the action of motor 46 and gearing 48, 49, 47. Compressed air is supplied by pipe 56 and the housing is vented through valve 51 in pipe 50, with a bypass 52 and relief valve 53. Steam, hot water, precoat mixture and feed liquid are supplied through pipes 22, 23, 24, 25, entering the housing through pipe 21. By suitable operation of the vent valve 51 and valves 22a, 23a, 24a and 25a, the filter is heated with steam, filled with precoat mixture and this recirculated until the liquid running through spouts 16a is clear; the feed liquid filtered until the cake reaches the required thickness; this sweetened-off and the muds washed off and discharged through pipe 21 and valve 27 to tank 28.

* * *

Clarification of Aqueous Organic Suspensions (First Carbonatation Juice, Beet Waste Water, Etc.). DOW CHEMICAL CO., of Midland, Mich., U.S.A. **812,228.** 1st March 1957; 22nd April 1959.—The suspension is limed and the rate of sedimentation of its impurities accelerated by the addition, in dilute aqueous solution, of a sulphonate of a high M.W. (polyvinyl aromatic) compound in a proportion of 0·01 to 10 lb of sulphonate per ton of solids in suspension. The sulphonate may be derived from a polyvinyl toluene or from a co-polymer of vinyl toluene and acrylonitrile containing 1–30% of the latter on weight of co-polymer.

* * *

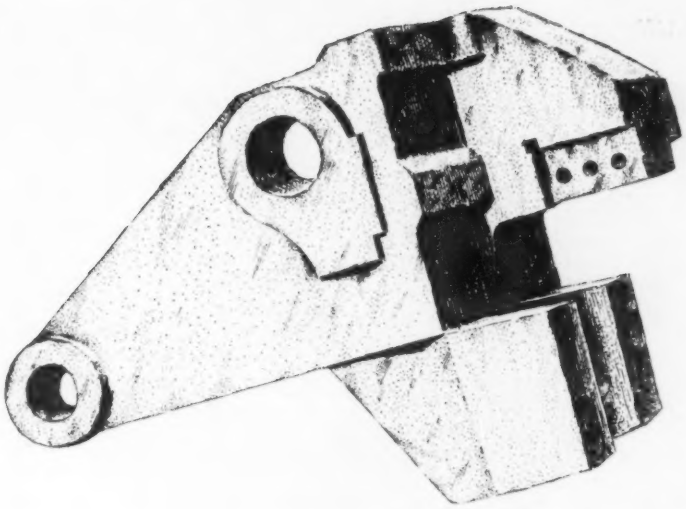
Extracting Sugar from Sugar Cane. NATIONAL CYLINDER GAS CO., of Chicago, Ill., U.S.A. **813,394.** 10th January 1956; 13th May 1959.—Sugar cane is cut into pieces of substantially circular shape, the length along the fibre axis being no greater than ½ inch (between ¼ and ⅜ inch). The pieces are formed into a suspension with 1–2 parts by volume of hot cane juice (of 10–17°Bx, and at a temperature of at least 150°F or 65°C), and the suspension introduced into the bottom of a tower up which the pieces are carried in counter current to a downward stream of heated water, finally leaving the top of the tower as exhausted cane. The heated water (of at least 150°F or 65°C) passes down the tower and is enriched with sugar, finally being withdrawn at the bottom and part partly used to make the suspension, the remainder going to process. The rate of draw-off is related to the rate of water addition and is such that the extraction time in the tower is at least 20 minutes (20–45 min).

* * *

UNITED STATES

Electrodialyzing Aqueous (Sugar) Solutions. W. JUDA and W. A. MCRAE, assrs. IONICS INC., of Cambridge, Mass., U.S.A. **2,863,813.** 14th September 1956; 9th December 1958.—Sugar solutions, of 20–40°Bx and pH 2–5, are passed through alternate chambers of a multi-membrane electrodialysis unit, a second electrolyte being passed through the other chambers except the electrode chambers in which is a third electrolyte. A direct current is passed, with periodic changes of direction, the sugar and second electrolyte streams also being interchanged. By this means, fouling of the membranes and consequent build up of resistance is reduced.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).



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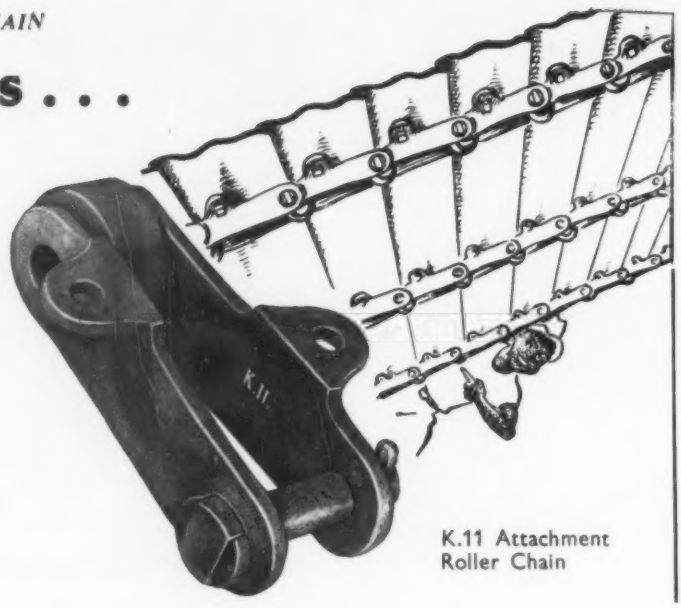
Under the slats . . .

Pennine Roller Chains with K.11 Attachments are made to run through many gruelling seasons of cane carrier service.

Correctly assembled telescopic bosses and hard-wearing rollers ensure true and free-running Chains for this work. Secure attachment of slats is made to the staggered side bars on each Link. Other Attachments to suit individual needs are also available with this type of Roller Chain.



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Sugar production runs smoother on

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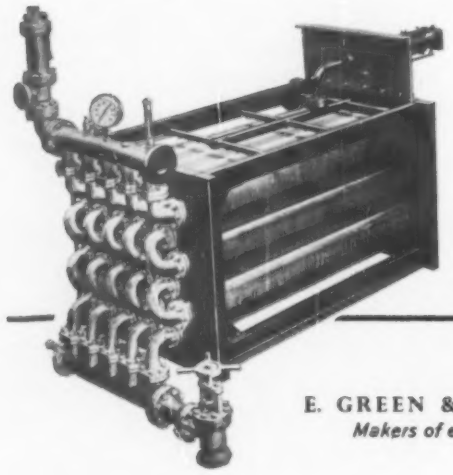
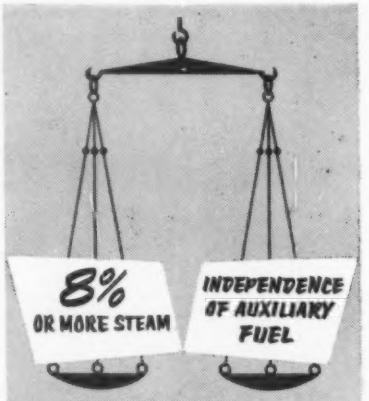
Much of the heat now lost in the boiler flue gases can be transferred to the boiler feed water by installing a 'GREEN'S ECONOMISER'. Every 10°F rise in feed water temperature saves 1% of fuel or gives an equivalent increase in steam production.

Sugar mills all over the world are already getting these benefits; why not you? Ask for full particulars of what can be done in *your* mills.





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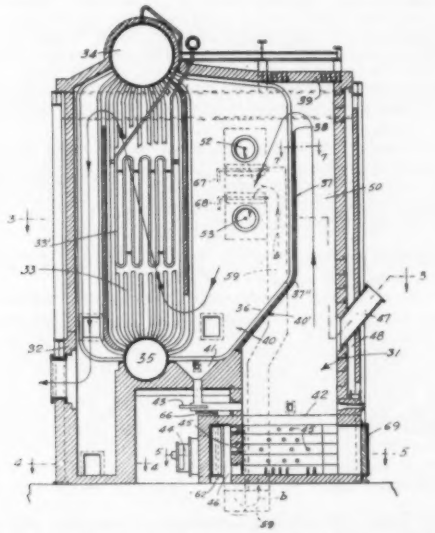
GE. 167

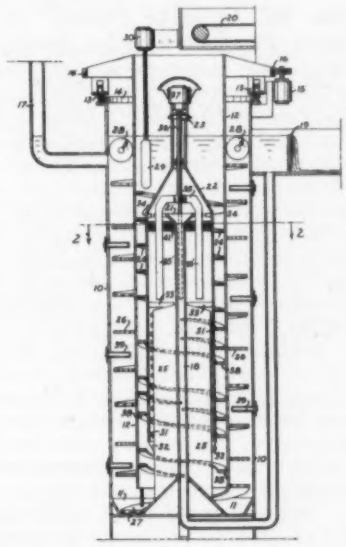
Combined Combustion Apparatus for Bagasse and (Oil) Vapour Generator. F. FALLA, of Milburn, N.J., U.S.A. **2,875,735.** 25th May 1955; 3rd March 1959. The steam generation part of the furnace is of a conventional two-drum type with the exception that the outer row 36 of the bank of tubes 33 are spaced outwardly and partly encased with refractory material of a wall structure 37 which constitutes the inner wall



of the bagasse furnace 31. The bottom part 40 of this wall acts as a guide to direct carried-over unburnt bagasse into the collector 41 from which it is returned to hearth 42 by a steam jet 43. Air is supplied by blower 44 to tuyères 45 by way of plenum chamber 46 which is also connected by duct 59 so that combustion air may flow in the direction of arrow *b* to the top of the boiler unit, entering coaxially with liquid fuel nozzles 52, 53.

* * *

Sugar Diffusing Apparatus. J. P. RUTH, of Denver, Colo., U.S.A. **2,876,143.** 27th February 1956; 3rd March 1959.—Beet cossettes supplied on conveyor 20 fall into the cylindrical chamber formed by the tubular well 12. This well is supported on the upper end of tank 10 by means of wheels 13 rotating on radial axes along an annular track 14, under the action of motor 15 engaged with the ring gear 16. The cossettes fall outside a hood 22 and skirt 31 and are carried down by the spiral flight 24 into the annular trough 11, when they are carried upwards by flight 26 and are withdrawn through conveyors 28. Some (38) of the flights 24 are spaced irregularly so as to compress the cossettes intermittently in order to improve extraction. Longitudinal fixed members 25 inside the well prevent co-rotation of juice with cossettes. Fresh water is admitted through pipe 17 and passes down the outside annular chamber, into the well 12, and enters the intake 21, passing down through pipe 18, and overflows from the upper trough over weir 19. Inside the stationary hood 22 is a driven shaft 36 carrying a spider 35 which is designed to impel concentrated juice through the slots 34 in order to recirculate it with the intention of improving extraction. A powered pulsator 29 is also immersed



in the liquid to vibrate or pulsate the liquid charge first receiving the cossette feed to improve leaching. The cartridges 39 inserted into the outer chamber, and the annular pocket 41 are containers of limestone so that acidic materials in the juice are neutralized.

* * *

Manufacture of Highly Pure Ethyl Alcohol. L. ALHÉRITIÈRE and F. X. POINCET, assrs. LES USINES DE MELLE S.A., of Saint-Leger-les-Melle, France. **2,878,167.** 8th October 1953; 17th March 1959.—In a continuous process, an impure solution of fermentation alcohol is fed to the mid-section of a purifying column and this heated to drive the fusel oil and other impurities to the top of the column. There they are collected on a plate inside the top of the column, and sufficient hot water is added to the impure fusel oil to maintain the alcohol concentration in the column at not more than 20% by weight. The fusel oil/water mixture separates into two layers (either inside or outside the column) the top fusel oil layer being withdrawn while the aqueous layer, containing not more than 10% by volume of organic material, is returned to the top of the column. Vapours above the level of the plate are distilled to separate head impurities, which are discarded, from the bottom products which are returned to the top of the column. Purified alcohol is removed from the base of the column.

* * *

Clarification Plant for Service and Waste Waters. A. SAMBRAUS, of Lüneberg, Germany. **2,880,877.** 21st November 1955; 7th April 1959.—See U.K.P. 807,308[1].

[1] *I.S.J.*, 1959, **61**, 156.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Avery Scales and Automatic Control. W. & T. Avery Ltd., Soho Foundry, Birmingham 40.

It is now possible to link the weighing operations carried out by standard Avery dial scales with one or more of the standard business machines, at the same time, if required, controlling the feed and discharge of materials to and from the scale. The possibilities of such developments are discussed in one new leaflet, "Avery revolutionising weight control", while one, a procedure based on a British Sugar Corporation installation, is illustrated in a second leaflet, "Avery scales". In this, a farmer sends his produce to the factory by road ; it passes over a weighbridge where the gross weight is recorded and stored on a punched card. The produce is discharged and the unladen truck returns to the weighbridge where the tare weight is recorded on a second punched card. The two cards are converted by an interpreter machine into a typewritten statement of the weights with the farmer's name and address incorporated. When passed to the central computing office, the nett weight, quality and code of payment punched on additionally, the cards are fed to a second interpreter which computes costs and provides a complete typewritten invoice giving full details, while the cards may be stored for reference if required.

* * *

New Grades of Kieselguhr. Charles H. Windschuegl Ltd., 1, Leadenhall Street, London E.C.3.

"80 Special" kieselguhr is a very high quality grade with a good white colour and large bulk volume. It is made up of carefully selected and balanced diatoms all within the range of 30–90 microns. This ensures full suspension during the complete filtration period. It has an excellent flow rate with extended period of cycle and above average clarification. "80 Special" is primarily devised for the brewing and other trades requiring a chemically inert kieselguhr which will give full clarity of filtrate without loss of speed.

"80 Quick" kieselghur is slightly off-white and gives a very fast filtration rate with medium clarification. It is specially recommended for applications where build-up of back pressure is to be delayed and when highly viscous liquids, such as heavy oils, or sugar syrup, are involved.

Five existing grades of kieselguhr, introduced in 1957, have all been further improved in colour and bulk density during the past few months, mainly as a consequence of revised process methods. Of these, "80 S. New" and "80 S.B." are especially suitable for sugar refineries.

All grades are calcined, double ground and air-sifted and weigh from 130 to 172 g/litre.

PUBLICATIONS RECEIVED

GEAR AND FLUID DRIVES. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

A new 48-page booklet, No. 2747, is entitled "Gearmotors, Motogears and Fluid drives" and describes the functions and characteristics of this equipment, including selection data, dimensions, overhung load ratings, mountings, and accessories.

* * *

PORTABLE ELECTROLYTIC CONDUCTIVITY MEASURING BRIDGE. Electronic Switchgear (London) Ltd., Letchworth, Herts.

A new leaflet, MC1 edition 2, describes the latest version of the instrument which is particularly suited to the study of water treatment for steam raising plant. The electrodes used are of carbon and the instrument is fitted with three ranges covering 0·1 to 100,000 micromhos/sq.cm./cm.

* * *

DRYER BULLETIN. Standard Steel Corporation, 5001 South Boyle Avenue, Los Angeles 58, Calif., U.S.A.

More than 75 years' experience in the design and manufacture of heavy rotary processing equipment provides the background for Standard Steel's new 28-page Bulletin describing their range of dryers, kilns, coolers, etc. for the chemical, food and allied industries, etc. Included are installation photographs, interior views of rotary dryers, a discussion on "How to Make Decisions on Rotary Processing Equipment", a thorough description of the many types of dryers and special equipment manufactured by the Company, and four engineering graphs for use in making calculations for new drying and cooling installations.

* * *

Taiwan Sugar Centrifugals Contract. A contract for sixty 48 × 30 inch 1200 r.p.m. centrifugals with auxiliary equipment worth over £320,000, has recently been signed in favour of Thomas Broadbent & Sons Ltd., of Huddersfield, England. The specification of the Taiwan Sugar Corporation for these machines was extremely detailed and tenders were submitted by most of the world's leading suppliers of sugar centrifugals. The machines are to be completely automatic except for operation of the feed valve. The Broadbent tender was not the lowest, but the contract has been placed as a result of the specification and a performance check by the T.S.C. on existing installations in other parts of the world. Two contracts for a further sixty machines each will be placed in due course, and the makers believe it is likely that these too will be for Broadbent centrifugals.

* * *

Russian Contract for U.K. Sugar Equipment. —Booker Brothers, McConnell & Co., Ltd., announce that their Engineering Group, working in association with Vickers-Armstrongs (Engineers) Ltd., have secured for their sugar machinery manufacturing subsidiaries, Duncan Stewart & Co. Ltd., of Glasgow and George Fletcher & Co. Ltd., of Derby, orders from the U.S.S.R. for over £1,500,000 worth of unit equipment for beet sugar factories for delivery this year.

The negotiation followed swiftly after a visit by a group of Russian sugar technologists to the Wissington and King's Lynn factories of the British Sugar Corporation where they saw plant manufactured by the Group.

The contract has just been signed in Moscow where representatives of Vickers and Bookers at present. Negotiations are also proceeding for securing a possible further contract for the supply of three conplete beet sugar factories to the value of about £11m.

* * *

U.K. Sugar Consortium. A consortium company known as Sunimac Ltd., has been formed to supply plant and equipment for certain sugar, chemical and other factories. Members of the consortium are Belliss & Morcom Ltd., Lancashire Dynamo Holdings, The Mirrlees Watson Co. Ltd., John Thompson Ltd., and Watson, Laidlaw & Co. Ltd.

BREVITIES

Austrian Beet Production[1].—The sugar beet harvest in 1958 totalled 1,699,324 tons in 1958 which represents an increase of 65% over the 10-year average of 1948–1957.

* * *

Egyptian Beet Factory[2].—It is reported, according to the Export Services Branch of the Board of Trade, that the Egyptian Government has purchased a beet sugar factory capable of processing 4000 tons of beet daily.

* * *

Puerto Rico Sugar Production Estimates[3].—Sugar production in Puerto Rico this season is now estimated at 1,106,978 short tons, raw value. As the domestic quota is 120,000 tons and the U.S. entitlement 1,166,375 tons it seems apparent that, failing a reduction of the U.S. quota, a substantial redistribution will be necessary later this year.

* * *

New Sugar Mill in Venezuela[4].—The new mill, Central Yaritagua, in the State of Yaracuy, began grinding operations in mid-December and is estimated to be capable of producing 12,000–14,000 tons of refined sugar. The mill is situated in the middle of 50,000 acres of sugar cane plantations which at present produce about 300,000 tons of sugar a year.

* * *

New Hawaiian Cane Cutter-Loader[5].—A new design of cane harvester is under construction by engineers of the H.S.P.A. Experiment Station. It operates on the principle used by commercial forage harvesters and cuts the cane, chops it into small pieces and tosses it into a cane transport unit trailed behind. When the transport unit is filled it is disengaged and replaced by an empty unit.

* * *

Mexican Sugar Exports[6].—Exports of sugar from Mexico in 1958 were almost double those of the previous year at 176,845 metric tons, tel quel, compared with 88,566 tons in 1957. The principal destinations were the U.S. (45,583 tons of raws, 17,718 tons of refined and 617 of standard whites), Greece (37,781 tons of refined), Spain (17,430 tons), Switzerland (16,266 tons), Iran (11,000 tons) and the U.K. (9703 tons of raws).

* * *

Swiss 1958 Beet Crop[7].—The beet crop in Switzerland in 1958 was a record at 282,000 tons, but the sugar content was low and averaged 14·6% compared with 16·5% in 1957. The campaign at Aarberg factory had to be extended by 4 weeks with detrimental effects on the sugar extraction. At its annual general meeting, the Association of Sugar Beet Growers of Eastern Switzerland took note that the share issue for financing a second sugar factory had been successfully taken up; it is intended that the factory will be built during the next two or three years.

* * *

The late R. F. Serro. We regret to report the death on May 18th of Robert F. Serro, senior research chemist of the Great Western Sugar Company. After obtaining his Master's degree at Purdue University in 1950 and except for a two-year period with the Dow Chemical Company, his brief but distinguished professional career was spent in the Research Laboratory of the Great Western Sugar Company where he played an important part in the discovery, isolation and identification of galactinol, a natural carboydrate occuring in sugar beet juice.

* * *

Bagasse Paper Factory in Argentina.[8] A report in *La Prensa* of 22nd April states that Dr. J. E. ATCHISON of the Pulp & Paper Projects Division of Parsons & Whittemore Inc. spent a week at Ingenio Ledesma in Jujuy with the object of studying the installation of a plant for making various types of paper, except newsprint, at the sugar factory. Bagasse would be the raw material, gas being used as a replacement fuel. The cost is calculated at $14 million, and capacity may be 100 tons per day while its operation, within two years, would reduce the present import requirements of $70 million's worth of paper and cellulose by 15%.

Czechoslovakian Milling Tandem for Egypt[9].—A cane milling tandem has been put in operation at Armant factory, Egypt, after delivery from the Skoda Works in Czechoslovakia. It is of 4000–5000 tons capacity and comprises a crusher and six mills, individually driven by steam turbines.

* * *

Greek Sugar Plan Progress[10]. Twelve tenders have been submitted for the 2000-ton beet sugar factory to be built near Larissa, in Thessaly, and the choice is expected soon. Beet seed has already been distributed in the area to provide a crop for when the factory is ready for operation. The Greek Government plans to erect two further sugar factories which will then cover the total Greek consumption of about 85,000 tons.

* * *

Tanganyika Project Postponed.[11]—The project of developing sugar cultivation and refining in the Kilombero Valley, as planned for a long time past by the Tanganyika Sugar Co. Ltd., has had to be postponed as the Government has decided that, because over-production could occur if this and other schemes at present contemplated were to materialise, they ought to have power to control this important industry. The Government has invited an overseas sugar expert to visit Tanganyika this year to advise it on legislation.

* * *

West Indies Sugar Production and Consumption.—The West Indies Sugar Association released the following data on 7th May 1959:

CROP RESULTS AND FORECASTS:

	Production		*Estimate*
	1957	1958	1959
Antigua	31,670	21,983	30,500
Barbados*	204,525	152,847	175,000
British Guiana ..	284,973	306,361	305,500
Jamaica	359,067	345,535	376,858
St. Kitts.....	44,794	42,169	52,450
St. Lucia	9,314	8,198	7,500
Trinidad	167,805	187,500	189,500
	1,102,148	1,064,593	1,137,308
St. Vincent	3,557	4,281	4,100
	1,105,705	1,068,874	1,141,408

LOCAL AND NEIGHBOURING CONSUMPTION:

		Estimate	*Available Export*
	1958	1959	1959
Antigua	1,597	1,500	29,000
Barbados*	12,038	10,500	165,506†
British Guiana ..	18,723	18,500	290,783†
Jamaica	60,934	61,848	315,060†
St. Kitts.....	4,648	4,970	47,480
St. Lucia	1,907	1,920	5,580
Trinidad	27,808	30,000	159,864†
	127,655	129,238	1,013,273
St. Vincent	2,902	3,000	1,100
	130,557	132,238	1,014,373

* Production and export figures include Fancy molasses.
† Includes stock at end of 1958.

[1] F. O. LICHT, *International Sugar Report*, 1959, **90**, (4), 34.
[2] C. Czarnikow Ltd., *Sugar Review*, 1959, (401), 68.
[3] C. Czarnikow Ltd., *Sugar Review*, 1959, (401), 68.
[4] *Fortnightly Review* (Bank of London & S. America Ltd.), 14th March 1959.
[5] *Sugar y Azúcar*, 1959, **54**, (5), 76–78.
[6] F. O. LICHT, *International Sugar Report*, 1959, **90**, (4), 37.
[7] *Neue Zürcher Zeitung*, 26th March 1959.
[8] *La Ind. Azuc.*, 1959, **64**, 174.
[9] *Czech. Heavy Industry*, 1959, (6), 33.
[10] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 10), 137.
[11] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 10), 140.

BREVITIES

New French Sugar Factory[1]. The competent French authorities have approved erection of a new sugar factory in the area of Chalons-sur-Marne.

* * *

Pakistan Sugar Machinery[2].—It is reported that the Pakistan Industrial Development Corporation workshops in Karachi are preparing to manufacture the machinery for two sugar factories planned for West Pakistan.

* * *

Venezuela Imports in 1959[3].—The Venezuelan Minister of Agriculture is reported to have stated that it will be necessary for that country to import nearly 100,000 tons of raw sugar this year for refining for domestic consumption. Venezuela is normally a substantial exporter but it is stated that the present position has been brought about by insufficient planting of cane.

* * *

Czech Sugar Factories for the U.S.S.R.[4]—Three further sugar factories are to be delivered to the U.S.S.R. by Czechoslovakia. Two will have daily capacities of 2500 tons and one of 1500 tons. The Czechoslovakian industry has supplied 15 sugar factories to the U.S.S.R. since 1954.

Danish Beet for Finland[5]. A contract has recently been signed calling for the supply of 60,000 tons to Finland from Denmark.

* * *

Thailand Sugar Factory[6].—A sugar factory of 800 tons daily capacity is to be supplied to Thailand by Taiyo Bussan Company of Japan. Shipment is to start in November.

* * *

Sugar in Ghana[7]. Investigations are to be made of the possibility of establishing sugar growing in the Volta river valley, with the object of establishing an industry to produce 50,000 tons of refined sugar a year.

* * *

New Italian Sugar Factories[8].—Northern Italian sugar industrialists have decided to build a new sugar factory in the Valle dell'Ofanto near Battipaglia and another in Sardinia where the output of sugar beet per hectare has been much larger than in the Po valley. These factories are to be put into operation in 1960.

* * *

New Dry Fondant[9].—A new dry fondant sugar is being made by Tate & Lyle, after considerable research. It is composed of 90% sucrose, 5% levulose and 5% dextrose, and resembles a dry soft-milled sugar. It is delivered to the baker in powder form and reconstituted by adding the correct amount of water and mixing.

* * *

Japanese Beet Campaign, 1958/59.[10]—The 1958/59 sugar beet campaign in Japan came to an end on 9th March last. During the season, which commenced at the beginning of October, 908,104 metric tons of beet were harvested from an area of 35,325 hectares. The sugar outturn amounted to 120,827 metric tons which compares with 85,727 tons in 1957/58.

* * *

Chemicals from Chile Sugar Factories[11].—The beet sugar producers of Chile estimate their sugar production this year at 47,000 tons. It has been reported, furthermore, that the factories intend to market several chemical products, and ethyl alcohol (2 million litres), ethyl and butyl acetates, butanol and acetone have been mentioned in this connexion. It is also intended to erect six further sugar factories.

* * *

New Zululand Mill Planned.[12] A new sugar mill to cost £1 m in the Enkwaleni valley, Zululand, to serve the Eshowe Melmoth and Nkwaleni districts, is planned. Growers are discussing whether to establish a cooperative to establish the mill or ask an existing company to do so. A major difficulty in the case of the cooperative proposal would be to obtain the necessary finance at a reasonable rate of interest.

* * *

Colombia Sugar Production.[13]—Despite earlier forecasts that sugar production this year would be below last season's outturn, it is now reported that, due to an extension of two mills in the Cali area, about 250,000 metric tons is expected to be produced. This compares with 242,523 tons last year and 215,000 tons in 1957.

Stock Exchange Quotations

London Stocks (*at 17th June*, 1959)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	17/–
Antigua Sugar Factory (£1)	17/–
Booker Bros. (10s)	28/–
British Sugar Corp. Ltd. (£1)	19/6
Caroni Ord. (2s)	4/9
Caroni 6% Cum. Pref. (£1)	17/3
Distillers Co. Ltd. (6s. 8d units)	27/–
Gledhow Chaka's Kraal (£1)	70/–
Hulett & Sons (£1)	81/3
Jamaica Sugar Estates Ltd. (5s units)	6/10¼
Leach's Argentine (10s units)	14/3
Reynolds Bros. (£1)	58/6
St. Kitts (London) Ltd. (£1)	62/–
Ste. Madeleine (Ord.) (£1)	34/–
Sena Sugar Estates (10s)	23/3
Tate & Lyle (£1)	49/3
Tate & Lyle Investments Ltd. (5s)	15/6
Trinidad Sugar (5s stock units)	28/6
United Molasses (10s stock units)	35/3
West Indies Sugar Co. Ltd. (£1)	25/–

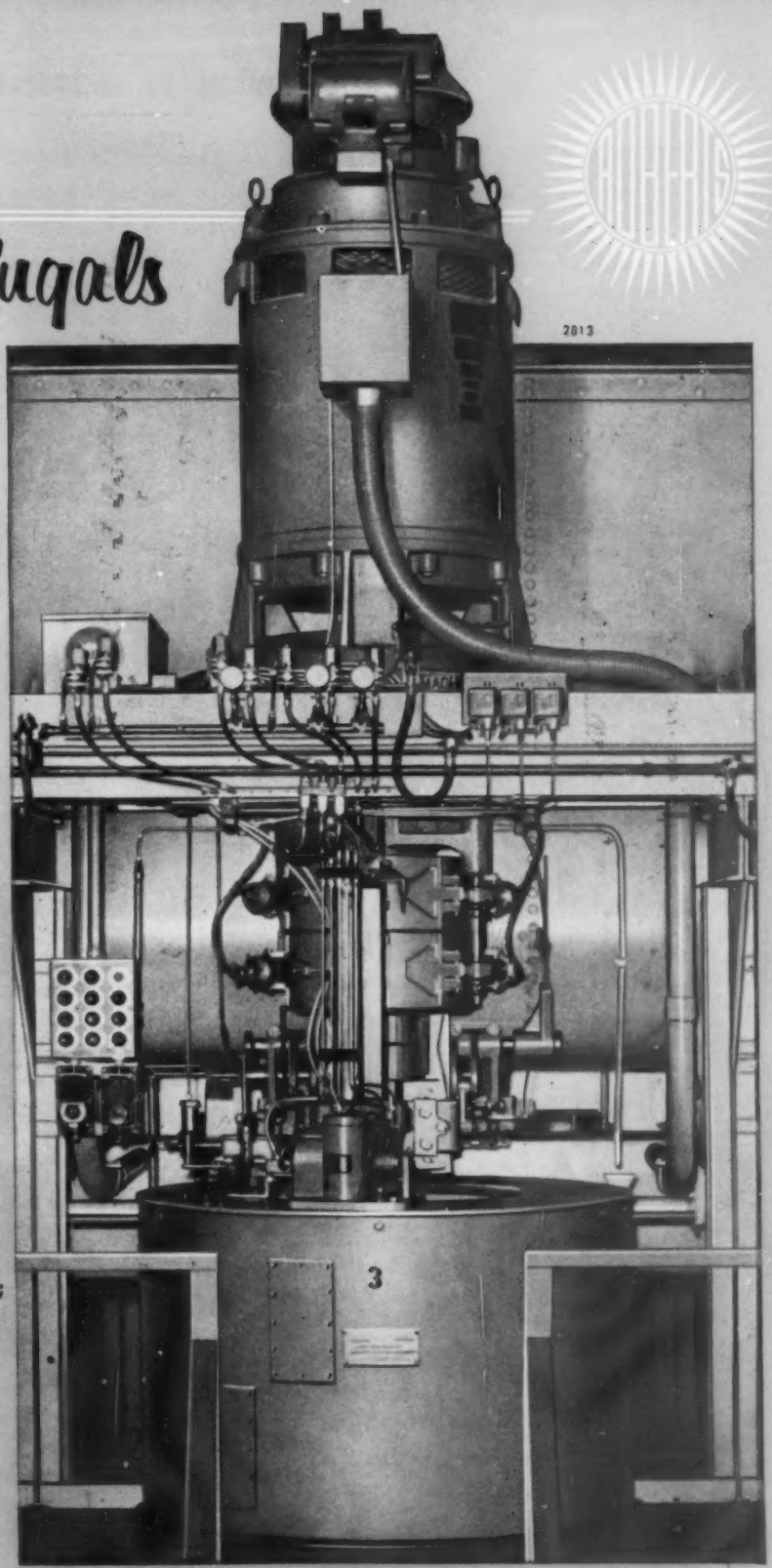
New York Stocks (*at 16th June* 1959)

	CLOSING MIDDLE $
American Crystal ($10)	42⅜
Amer. Sugar Ref. Co. ($100)	31¾
Central Aguirre ($5)	22⅛
Cuban American ($10)	20½
Great Western Sugar	26⅞
South P.R. Sugar	23
United Fruit Co.	35¼
West Indies Sugar Corp. ($1)	36

[1] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 11), 149.
[2] F. O. LICHT, *International Sugar Report*, 1959, **90**, (4), 39.
[3] C. Czarnikow Ltd., *Sugar Review*, 1949, (400), 64.
[4] F. O. LICHT, *International Sugar Report*, 1959, **90**, (Supp. 9), 121.
[5] F. O. LICHT, *International Sugar Report*, 1959, **91**, (Supp. 10), 136.
[6] F. O. LICHT, *International Sugar Report*, 1959, **90**, (4), 39.
[7] *Commonwealth Producer*, 1959, (371), 109.
[8] *Public Ledger*, 16th May 1959.
[9] *Bakers' Review*; through *Travers' Circular*, 9th May, 1959.
[10] C. Czarnikow Ltd., *Sugar Review*, 1959, (404), 81.
[11] F. O. LICHT, *International Sugar Report*, 1959, **90**, (Supp. 9), 124.
[12] *Commonwealth Producer*, 1959 (371), 109.
[13] C. Czarnikow Ltd., *Sugar Review*, 1959, (405), 84.

MORE

Roberts Centrifugals



Roberts Centrifugals include **MORE** than you can see. **MORE** than the specifications indicate. **MORE, TOO,** than the invoice covers.

For into every Roberts machine goes forty years of "thinking ahead;" forty years of building constantly improved centrifugals; forty years of correlating our equipment with the other phases of sugar processing. Into every machine goes Western States experience. Experience unapproached by any other sugar centrifugal manufacturer.

In the past decade most of the innovations in operation and automation of sugar centrifugal equipment were introduced by Western States, on Roberts Centrifugals.

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Trust Western States for MORE!

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WE THINK AHEAD

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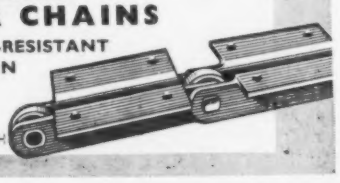

BUYERS' GUIDE

Certain of the classifications have sub-headings for individual types of equipment. Specialist makers appear under these sub-headings, while inclusion of manufacturers under the general headings implies that they supply all or most of the types of equipment described by the sub-headings.

Accumulators, Hydraulic.
George Cohen, Sons & Co. Ltd.
Edwards Engineering Corp.
Soc. Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

Accumulators, Steam.
see Steam Storage Equipment.

Air Clutches.
Farrel-Birmingham Co. Inc.

Air Filters.
A.B. Svenska Fläktfabriken
United Norit Sales Corporation Ltd.

Air Heaters.
E. Green & Son Ltd.
A.B. Svenska Fläktfabriken
Thermal Efficiency Ltd.
Wellington Tube Works Ltd.

Alcohol Plant.
A.P.V. Co. Ltd., Chemical Engineering Division.
Bennett, Sons & Shears Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
George Clark & Sons (Hull) Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
Honolulu Iron Works Co.
Lepage, Urbain & Cie.
S. P. E. I. Chim.
Stork-Werkspoor N.V. (V.M.F.)
Technoexport Czechoslovakia.

Anti-foaming Agents.
Chas. H. Windschuegl Ltd.

Asbestos Products.
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.

Bagasse Depithing Equipment.
Lyddon & Co. Ltd.

Bagasse Furnaces.
Babcock & Wilcox Ltd.
John Thompson Water Tube Boilers Ltd.

Bagasse—Paper & Board Production.
Krauss-Maffei-Imperial G.m.b.H. & Co.
Lyddon & Co. Ltd.

Barges (Dumb or Powered).
Fairmile Construction Co. Ltd.

Bearings and Pillow Blocks.
Link-Belt Company.
Ransome & Marles Bearing Co. Ltd.
Stephens-Adamson Mfg. Co.

Beet Diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Soc. Fives Lille-Cail.
Etablissements A. Olier.
Salzgitter Maschinen A.G.
Duncan Stewart & Co. Ltd.
U.C.M.A.S.

Beet Harvesters.
Catchpole Engineering Co. Ltd.

Beet Hoes.
Martin's Cultivator Co. Ltd.
S.K.H. & Son (Salopian-Kenneth Hudson & Son).

Beet Seed Rubbing Machines.
Cocksedge & Co. Ltd.

Beet Slicers.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Köllmann & Gruhn
Mitchell Engineering Ltd.
H. Putsch & Comp.

Beet Tail Utilization Plant.
Köllmann & Gruhn

Beet Tare House Equipment.
Cocksedge & Co. Ltd.

Beet Washing Plant.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
Cocksedge & Co. Ltd.
Mitchell Engineering Ltd.
Salzgitter Maschinen A.G.

Bentonite.
F. W. Berk & Co. Ltd.
Farnell Carbons Ltd.
The Fullers' Earth Union Ltd.

Boiler Water Treatment.
John Thompson-Kennicott Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Boilers, Water Tube.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Davey, Paxman & Co. Ltd.
Foster Wheeler Ltd.
International Combustion (Export) Ltd.
Mitchell Engineering Ltd.
John Thompson Water Tube Boilers Ltd.

Brushware—All Classes.
The Kleen-e-ze Brush Co. Ltd.

Bulk Handling.
see Conveyors *and* Elevators.

Cane Cars and Trailers.
J. Brockhouse & Co. Ltd.
Cary Iron Works.
Robert Hudson Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Markham Traction Ltd.
Orenstein & Koppel Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S.I. International Divn., U.S. Industries, Inc.
Whitlock Brothers Ltd.

Cane Car Tippers.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Mitchell Engineering Ltd.
Duncan Stewart & Co. Ltd.
Strachan & Henshaw Ltd.

Cane Carts.
Cary Iron Works.
Robert Hudson Ltd.
Markham Traction Ltd.
Spoorijzer N.V. Delft.
Whitlock Brothers Ltd.

Cane Cultivation Equipment.
Broussard Machine Co.
Rotary Hoes Ltd.

Cane Harvesters.
Cary Iron Works.

Cane Loaders.
Broussard Machine Co.
Cary Iron Works
Whitlock Brothers Ltd.

Cane Slings.
Robert Hudson Ltd.
Krupp-Dolberg G.m.b.H.
Parsons Chain Co. Ltd.

Cane Transpor tor Bulk Sugar Barges.
Fairmile Construction Co. Ltd.

Carbon, Decolorizing.
Activated Carbons & Chemicals Ltd.
C.E.C.A.
The Clydesdale Chemical Co. Ltd.
Farnell Carbons Ltd.
Lurgi Gesellschaft für Chemotechnik m.b.H.
Suchar Sales Corporation.
The Sugar Manufacturers' Supply Co. Ltd.
United Norit Sales Corporation Ltd.

Carbonatation Equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cane Sugar Divn., Dorr-Oliver Inc.
George Fletcher & Co. Ltd.
Ateliers Neyret Beylier.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Walter Thron G.m.b.H.

Cement (Sugar-resistant).
Lafarge Aluminous Cement Co. Ltd.

Centrifugals and Accessories.
Birtley Engineering Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co., A.G.
International Combustion (Export) Ltd.
Krauss-Maffei-Imperial G.m.b.H. & Co.
Pott, Cassels & Williamson Ltd.
Machinefabriek Reineveld N.V.
Salzgitter Maschinen A.G.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Centrifugals and Accessories—*continued*
Watson, Laidlaw & Co. Ltd
The Western States Machine Co.

Centrifugal Backings.
Ets Krieg et Zivy.

Centrifugal Motors.
Hinz Elektromaschinen und Apparatebau.
Western States Machine Co.

Centrifugal Screens.
Cane Sugar Divn., Dorr-Oliver Inc.
Ferguson Perforating & Wire Co.
Fontaine & Co.
Hein, Lehmann & Co. A.G.
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Tiss-Metal

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Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Parsons Chain Co. Ltd.
Pennine Chainbelt Co. Ltd.
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Stordy Engineering Ltd.

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Associated Chemical Companies (Sales) Ltd.
The General Chemical & Pharmaceutical Co. Ltd.
D. W. Haering & Co. Inc.
The Sugar Manufacturers' Supply Co. Ltd.

Lead Acetate, Basic, Doctor Horne's.
Riedel-de Haën A.G.

Sulphur, Roll.
F. W. Berk & Co. Ltd.

Sulphuric Acid.
F. W. Berk & Co. Ltd.

Chemical Plants.
A.P.V. Co. Ltd., Chemical Engineering Division.
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Blairs Ltd.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
Davey, Paxman & Co. Ltd.
L. A. Mitchell Ltd.
The Power-Gas Corp. Ltd.
S.P.E.I. Chim.
Duncan Stewart & Co. Ltd.
John Thompson (Dudley) Ltd.

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BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cane Sugar Divn., Dorr-Oliver Inc.
Eimco (Great Britain) Ltd.
George Fletcher & Co. Ltd.
Johns-Manville International Corp.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Walter Thron G.m.b.H.
Westfalia Separator A.G.

Colorimeters.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.
The Sugar Manufacturers Supply Co. Ltd

Conveyors and Elevators.
Babcock & Wilcox Ltd.
Bennett, Sons & Shears Ltd.
Birtley Engineering Ltd.
William Boulton Ltd.
Hugh Campbell (London) Ltd.
Cocksedge & Co. Ltd.
George Cohen, Sons & Co. Ltd.
Ewart Chainbelt Co. Ltd.
George Fletcher & Co. Ltd.
William Gardner & Sons (Gloucester) Ltd.
Hein, Lehmann & Co. A.G.
International Combustion (Export) Ltd.
John King & Co. (Leeds) Ltd.
Link-Belt Company.
The Mirrlees Watson Co. Ltd.
Mitchell Engineering Ltd.
Pott, Cassels & Williamson Ltd.
Redler Conveyors Ltd.
Simon Handling Engineers Ltd.
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The Squier Corporation.
Strachan & Henshaw Ltd.
John Thompson Conveyor Co. Ltd.
Whitlock Brothers Ltd.

Apron Conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Belt and Bucket elevators.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Belt Conveyors.
Buhler Brothers.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.
Stephens-Adamson Mfg. Co.
Richard Sutcliffe Ltd.

Bucket elevators.
Buhler Brothers.
New Conveyor Co. Ltd.
Sandvik Steel Band Conveyors Ltd.
Richard Sutcliffe Ltd.

Chain and bucket elevators.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Chain conveyors.
Buhler Brothers.
New Conveyor Co. Ltd.
Richard Sutcliffe Ltd.

Drag-bar conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Feeder conveyors.
Buhler Brothers.
see also Sugar Throwers and Trimmers.

Flight conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Grasshopper Conveyors.
Thomas Broadbent & Sons Ltd.
New Conveyor Co. Ltd.

Plate conveyors.
New Conveyor Co. Ltd.
Richard Sutcliffe Ltd.

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Henry Simon Ltd.

Scraper conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Screw conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Steel Band Conveyors.
Sandvik Steel Band Conveyors Ltd.

"U"-link conveyors.
Marco Conveyor & Engineering Co. Ltd.
New Conveyor Co. Ltd.

Conveyors & Elevators (Mobile).
Buhler Brothers.

Conveyor Belt Rotary Brushes.
The Kleen-e-ze Brush Co. Ltd

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell (1952) Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Buttner Works (Canada) Ltd.
George Clark & Sons (Hull) Ltd.
Dunford & Elliott Process Engineering Ltd.
Richard Simon & Sons Ltd.
Standard Steel Corporation.
A.B. Svenska Fläktfabriken
Stork-Werkspoor N.V. (V.M.F.).
see also Dryers.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Heenan & Froude Ltd.

Cranes.
Babcock & Wilcox Ltd.
Cary Iron Works.
George Cohen, Sons & Co. Ltd.
Orenstein & Koppel Ltd.
The Vaughan Crane Co. Ltd.

Crystallizers.
Bennett, Sons & Shears Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
The Power-Gas Corp. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
John Thompson (Dudley) Ltd.

Cube-making Machinery.
Maschinenfabrik Buckau R. Wolf A.G.
The Mirrlees Watson Co. Ltd.
Standard Steel Corporation.

Cube Sugar Moulding, Ranging and Packeting Plant.
Chambon Ltd.

Cube Wrapping Machines.
SAPAL.
SIG Swiss Industrial Company.

Decolorizing Plants.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.
United Norit Sales Corporation Ltd.

Decolorizing Resins.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.

Deliming Plants.
Cane Sugar Divn., Dorr-Oliver Inc.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Demineralization Plants.
Cane Sugar Divn., Dorr-Oliver Inc.
IMACTI-Amsterdam.
Paterson Engineering Co. Ltd.
The Permutit Co. Ltd.
Machinefabriek Reineveld N.V.

Diatomaceous Earth, *see* **Filter-Aids.**

Distillery Plant, *see* **Alcohol Plant.**

Drainage and Ridging Machinery.
James A. Cuthbertson Ltd.
Whitlock Brothers Ltd.

Drives, Variable Speed.
David Brown Industries Ltd., Radicon Divn.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd.

Dryers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Buell (1952) Ltd.
Büttner-Werke A.G.
Buttner Works Inc.
Buttner Works (Canada) Ltd.
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George Cohen, Sons & Co. Ltd.
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George Fletcher & Co. Ltd.
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The Squier Corporation.
Standard Steel Corporation.
Duncan Stewart & Co. Ltd.
A.B. Svenska Fläktfabriken.
Stork-Werkspoor N.V. (V.M.F.).

Duckboards.
Grill Floors Ltd.

Dust Control Equipment.
Buell (1952) Ltd.
Büttner-Werke A.G.
Dallow Lambert & Co. Ltd.
Dunford & Elliott Process Engineering Ltd.
H. Pontifex & Sons Ltd.
A.B. Svenska Fläktfabriken.

Economizers.
George Cohen, Sons & Co. Ltd.
Soc. Fives Lille-Cail.
E. Green & Son Ltd.
Senior Economisers Ltd.

Electric Heating Tapes and Mantles.
Isopad Ltd.

Electric Motors.
George Cohen, Sons & Co. Ltd.
The Harland Engineering Co. Ltd.
Hinz Elektromaschinen und Apparatebau.
Lancashire Dynamo & Crypto Ltd.

Electric Power Generators.
George Cohen Sons & Co. Ltd.
Duncan Stewart & Co. Ltd.

Electronic Equipment.
Cambridge Instrument Co. Ltd.
Evershed & Vignoles Ltd.
Kelvin & Hughes (Industrial) Ltd.
Lancashire Dynamo Electronic Products Ltd.
Henry Simon Ltd.

Engines, Diesel.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
Davy, Paxman & Co. Ltd.
Orenstein & Koppel Ltd.

Engines, Steam.
Ashworth & Parker Ltd.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.

Entrainment Separators.
Honolulu Iron Works Co.

Evaporators and Condensing Plant.
Bennett, Sons & Shears Ltd.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia
Walter Thron G.m.b.H.
Wellington Tube Works Ltd.
Worthington-Simpson Ltd.

Filters.
William Boulton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Cohen, Sons & Co. Ltd.

Filters—*continued.*
Cotton Bros. (Longton) Ltd.
Davey, Paxman & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
International Combustion (Export) Ltd.
Krauss-Maffei-Imperial G.m.b.H. & Co.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).

Bag pressure filters.
A. F. Craig & Co. Ltd.
Filtres Philippe S.A.
Walter Thron G.m.b.H.

Diatomite filters.
Paterson Engineering Co. Ltd.
Sparkler Manufacturing Co.

Filter presses.
S. H. Johnson & Co. Ltd.

Gravity & Pressure filters.
The Permutit Co. Ltd.

Iron removal filters.
The Permutit Co. Ltd.

Leaf filters.
Cane Sugar Divn., Dorr-Oliver Inc.
Enzinger Division, The Duriron Co. Inc.
Ferguson Perforating & Wire Co.
L. A. Mitchell Ltd.
Filtres Philippe S.A.
A. & W. Smith & Co. Ltd.
Sparkler International Ltd.
Sparkler Manufacturing Co.
Suchar Sales Corporation.

Plate and Frame filters.
Blairs Ltd.
S. H. Johnson & Co. Ltd.
John McNeil & Co. Ltd.

Pressure filters.
Cane Sugar Divn., Dorr-Oliver Inc.
Eimco (Gt. Britain) Ltd.
Enzinger Division, The Duriron Co. Inc.
Sparkler Manufacturing Co.
Suchar Sales Corporation.

Rotary vacuum filters.
Cane Sugar Divn., Dorr-Oliver Inc.
Eimco (Gt. Britain) Ltd.

Upflow filters.
IMACTI Amsterdam.

Filter-Aids.
F. W. Berk & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
C.E.C.A.
Dicalite Dept., Great Lakes Carbon Corp.
Farnell Carbons Ltd.
T. B. Ford Limited.
Johns-Manville International Corp.
Scottish Diatomite Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Chas. H. Windschuegl Ltd.

Filtercloths.
British Ropes Ltd.
Cotton Bros. (Longton) Ltd.
Heath Filtration Ltd.
G. H. Heath & Son (1952) Ltd.
Samuel Hill Ltd.
S. H. Johnson & Co. Ltd.
Multi-Metal Wire Cloth Co. Inc.
Henry Simon Ltd.
Tiss-Metal.

Filter-Leaves.
Cane Sugar Divn., Dorr-Oliver Inc. (*Sweetland*).
Enzinger Division, The Duriron Co. Inc. (Angola).
Ferguson Perforating & Wire Co.
Multi-Metal Wire Cloth Co. Inc.
A. & W. Smith & Co. Ltd.
Sparkler International Ltd.
Sparkler Manufacturing Company.

Filter Papers.
W. & R. Balston Ltd.
T. B. Ford Limited.
The General Chemical & Pharmaceutical Co. Ltd.
G. H. Heath & Son (1952) Ltd.
S. H. Johnson & Co. Ltd.
Macherey, Nagel & Co., Inh. Dr. Ing. Adolf Radmacher.
Carl Schleicher & Schüll.
Sparkler Manufacturing Company.
The Sugar Manufacturers' Supply Co. Ltd.

Flanges.
Kirk & Co. (Tubes) Ltd. (*Steel, Stainless Steel*)

Flowmeters.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Kelvin & Hughes (Industrial) Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.
Wright Rain Ltd. (*Irrigation*).
Wright Rain Africa (Pvt.) Ltd. (*Irrigation*).

Friction Materials (Industrial).
Johns-Manville International Corp.

Fullers' Earth.
The Fullers' Earth Union Ltd.

Gearing, *see* Reduction Gears.

Gearmotors.
David Brown Industries Ltd., Coventry Gear Divn.
Crofts (Engineers) Ltd.
Hinz Elektromaschinen und Apparatebau.

Grabs, Cane and Beet.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

Heat Exchangers, Air-cooled.
Wellington Tube Works Ltd.

Heat Exchangers, Plate Type.
A.P.V. Co. Ltd., Chemical Engineering Division.
Babcock & Wilcox Ltd.
British Boiler Accessories Ltd.
George Cohen, Sons, & Co. Ltd.

Heat Exchangers, Tubular.
Babcock & Wilcox Ltd.
Blairs Ltd.
British Boiler Accessories Ltd.
George Clark & Sons (Hull Ltd.
George Fletcher & Co. Ltd.
Foster Wheeler Ltd.
S.P.E.I. Chim
John Thompson Water Tube Boilers Ltd.
Wellington Tube Works Ltd.

Hydraulic Controls for Valves, etc.
Edwards Engineering Corp.
Duncan Stewart & Co. Ltd.

Instruments, Process Control.
Beckman Instruments Inc.
Bellingham & Stanley Ltd.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Electroflo Meters Co. Ltd.
Evershed & Vignoles Ltd.
Hilger & Watts Ltd.
Kelvin & Hughes (Industrial) Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Controls Ltd.
John Thompson Instrument Co. Ltd.

Insulation, Thermal (Heat and Cold).
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.
William Kenyon & Sons Ltd.
Lafarge Aluminous Cement Co. Ltd.

Ion Exchangers.
Cane Sugar Divn., Dorr-Oliver Inc.
Farnell Carbons Ltd.
IMACTI-Amsterdam.
The Permutit Co. Ltd.
Rohm & Haas Company.
John Thompson-Kennicott Ltd.

Irrigation Equipment.
Evenproducts, Evesham.
Farrow & Sons Ltd.
Markham Traction Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Jointings, *see* Packings and Gaskets.

Juice Heaters.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Mitchell Engineering Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd
Stork-Werkspoor N.V. (V.M.F.)
Walter Thron G.m.b.H.

Juice Scales.
Butz & Leitz G.m.b.H.
George Fletcher & Co. Ltd.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
see also Weighing Machines.

Juice Strainers and Screens.
Blairs Ltd.
William Boulton Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Cocksedge & Co. Ltd.
Dei-Con Eastern Corporation.
Cane Sugar Divn., Dorr-Oliver Inc.

Juice Strainers and Screens—*continued*
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Link-Belt Company.
John McNeil & Co. Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Russell Constructions Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Juice and Syrup Mixers.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Choquenet L. Fonderies et Ateliers.
George Clark & Sons (Hull) Ltd.
Gutehoffnungshütte Sterkrade A.G.
L. A. Mitchell Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd

Knives, Beet.
Köllmann & Gruhn.
H. Putsch & Comp.

Knives, Milling.
Blairs Ltd
BMA Braunschweigische Maschinenbauanstalt.
Broussard Machine Co.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.

Knives, Milling, Portable Grinders.
Flexotube (Liverpool) Ltd.

Laboratory Apparatus and Equipment.
International Combustion (Export) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
The Tintometer Ltd.

Electric Heating appliances.
Isopad Ltd.
see also Laboratory Instruments *and* Saccharimeters and Polarimeters, *etc.*

Laboratory Instruments.
Beckman Instruments Inc.
Belliss & Morcom Ltd.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Degenhardt & Co. Ltd.
Evershed & Vignoles Ltd.
A. Jobin & G. Yvon.
Rotameter Manufacturing Co. Ltd.
Sugar Manufacturers' Supply Co. Ltd.
John Thompson Instrument Co. Ltd.

Refractometers.
Bellingham & Stanley Ltd.
Hilger & Watts Ltd.
Schmidt & Haensch.

Laboratory Reagents.
The General Chemical & Pharmaceutical Co. Ltd.
Riedel-de Haën A.G.
The Sugar Manufacturers' Supply Co. Ltd.

Ladders, Steel Lattice.
Grill Floors Ltd.

Lime Density Meters.
Rotameter Manufacturing Co. Ltd.

Liming Equipment.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
Cocksedge & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
H. Putsch & Comp.
Salzgitter Maschinen A.G.

Locomotives, Diesel.
W. G. Bagnall Ltd.
Andrew Barclay, Sons & Co. Ltd.
George Cohen, Sons & Co. Ltd.
The Drewry Car Co. Ltd.
F. C. Hibberd & Co. Ltd.
Robert Hudson Ltd.
Hudswell, Clarke & Co. Ltd.
Hunslet Engine Co. Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Orenstein & Koppel Ltd.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S.I. International Divn., U.S. Industries Inc.

Magnetic Separators.
Electromagnets Ltd.
Permag Ltd.
Rapid Magnetic Machines Ltd.

Massecuite Heat Treating Equipment.
Blairs Ltd.
George Fletcher & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Pott, Cassels & Williamson Ltd.
A. & W. Smith & Co. Ltd.
The Western States Machine Co. (*Stevens System*).

Mechanical Crop Thinning Machines.
S.K.H. & Son (Salopian-Kenneth Hudson & Son).

Metal Detectors.
Metal Detection Ltd.

Mill Hydraulics.
Edwards Engineering Corp.
The Mirrlees Watson Co. Ltd.
Duncan Stewart & Co. Ltd.

Mill Rolls.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
G. M. Hay & Co. Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.

Mill Rolls—*continued*
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.

Mill Roll Movement Indicators and Recorders.
Edwards Engineering Corp.

Milling Plant.
Alpine A.G.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
David Brown Industries, Ltd., General Gear Division.
David Brown Industries Ltd., Jackson Division.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Farrel-Birmingham Co. Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
G. M. Hay & Co. Ltd.
International Combustion (Export) Ltd.
Kek Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.
see also Shredders.

Molasses Tanks.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
Mechans Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.

Packeting Machinery.
Brecknell, Dolman & Rogers Ltd.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.
Richard Simon & Sons Ltd.
SIG Swiss Industrial Company.

Packings and Gaskets.
The Cape Asbestos Co. Ltd.
Johns-Manville International Corp.

Pans, Vacuum.
Bennett, Sons & Shears Ltd.
Blairs Ltd.
William Boulton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
John McNeil & Co. Ltd.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.

Pans, Vacuum—*continued*
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.)
Technoexport Czechoslovakia.

Paper and Board from Bagasse.
Lyddon & Co. Ltd.

Pipes, Steam.
Kirk & Co. (Tubes) Ltd.
Duncan Stewart & Co. Ltd.
Talbot Stead Tube Co. Ltd.
Wellington Tube Works Ltd.

Pipe Fittings.
see Tube Fittings.

Ploughs—Disc.
David Brown Industries Ltd., Tractor Division.
Krupp-Dolberg G.m.b.H.
Martin's Cultivator Co. Ltd.
Ransomes Sims & Jefferies Ltd.
S.K.H. & Son (Salopian-Kenneth Hudson & Son).

Ploughs—Share.
David Brown Industries Ltd., Tractor Division.
Krupp-Dolberg G.m.b.H.
Ransomes Sims & Jefferies Ltd.

Polythene Bag Sealer.
The Thames Sack & Bag Co. Ltd. Packaging Machinery Division.

Portable Water Mains.
Evenproducts, Evesham.

Power Transmission Equipment.
Crofts (Engineers) Ltd.
Farrel-Birmingham Co. Inc.
Heenan & Froude Ltd.
William Kenyon & Sons Ltd.

Pressure Gauges.
The British Rototherm Co. Ltd.

Printing Machinery—Rotary Multi-Colour for Sugar Cartons and Bags, etc.
Chambon Ltd.
Fr. Hesser Maschinenfabrik A.G.

Pulverizers, Sugar.
Alpine A.G.
George Cohen, Sons & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Kek Ltd.
Henry Simon Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Pumps.
BMA Braunschweigische Maschinenbauanstalt.
Cellulose Development Corp. Ltd.
George Cohen, Sons & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
The Duriron Company Inc.
Farrow & Sons Ltd.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Harland Engineering Co. Ltd.
International Combustion (Export) Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Worthington-Simpson Ltd.

Boiler Feed pumps.
Saunders Valve Co. Ltd.

Centrifugal pumps.
Saunders Valve Co. Ltd.

Corrosion-proof pumps.
L. A. Mitchell Ltd.
Mitchell Engineering Ltd.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.

Gear pumps.
David Brown Industries Ltd., General Gear Divn.

Irrigation Pumps.
Markham Traction Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.

Molasses Pumps.
Mono Pumps Ltd.

Positive-action Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.

Rotary Pumps.
Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Machinefabriek Reineveld N.V.

Self-Priming Pumps.
Saunders Valve Co. Ltd.

Sump Pumps.
Saunders Valve Co. Ltd.

Vacuum Pumps.
see Vacuum Pumps.

Railway, *see* Locomotives *and* Track.

Reduction Gears.
David Brown Industries Ltd., General Gear Division.
David Brown Industries Ltd., Radicon Divn.
Maschinenfabrik Buckau R. Wolf A.G.
George Cohen, Sons & Co. Ltd.
Crofts (Engineers) Ltd.
Farrel-Birmingham Co. Inc.
William Gardner & Sons (Gloucester) Ltd.
William Kenyon & Sons Ltd.
The Power Plant Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.

Refinery Equipment.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Mechans Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Stordy Engineering Ltd.
Suchar Sales Corporation.
Technoexport Czechoslovakia.

Refractory Bricks.
General Refractories Ltd.
Johns-Manville International Corp.
The Leeds Fireclay Co. Ltd.
John G. Stein & Co. Ltd.

Refractory Cement.
General Refractories Ltd.
Johns-Manville International Corp.
Lafarge Aluminous Cement Co. Ltd.
The Leeds Fireclay Co. Ltd.
John G. Stein & Co. Ltd.

Rotary Hoes.
Rotary Hoes Ltd.

Rubber Belt Cane Carriers.
Farrel-Birmingham Co. Inc.

Saccharimeters and Polarimeters.
Bellingham & Stanley Ltd.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.
Schmidt & Haensch.
The Sugar Manufacturers' Supply Co. Ltd.

Sack Closing Machines.
Thomas C. Keay Ltd.
The Sack Filling & Sewing Machine Syndicate Ltd.
The Thames Sack & Bag Co. Ltd., Packaging Machinery Division. (*portable*)

Sack Filling Machines.
Brecknell, Dolman & Rogers Ltd.
Librawerk.
Richardson Scale Co. Ltd.
Richard Simon & Sons Ltd.

Sack Printing Machines.
Thomas C. Keay Ltd.

Sampling Equipment.
Birtley Engineering Ltd.

Scaffold boards.
Grill Floors Ltd.
Open Steel Flooring Ltd.

Scale Removal and Prevention.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
The Geigy Company Ltd.
D. W. Haering & Co. Inc.
The Kleen-e-ze Brush Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Screens, Centrifugal, *see* **Centrifugal Screens.**

Screens, Vibrating.
William Boulton Ltd.
Büttner-Werke A.G.
Cocksedge & Co. Ltd.
Dei-Con Eastern Corporation.
William Gardner & Sons (Gloucester) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
John McNeil & Co. Ltd.
Multi-Metal Wire Cloth Co. Inc.
Russell Constructions Ltd.
Spencer (Melksham) Ltd.
Duncan Stewart & Co. Ltd.
Tiss-Metal.
see also Juice Strainers and Screens.

Self-cleaning Strainers.
Ashworth & Parker Ltd.

Ship Loading installations.
Buhler Brothers.
Mitchell Engineering Ltd.
Simon Handling Engineers Ltd.

Shredders.
BMA Braunschweigische Maschinenbauanstalt.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gruendler Crusher & Pulverizer Co.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.

Skip Hoists.
Hugh Campbell (London) Ltd.
Marco Conveyor & Engineering Co. Ltd.
Mitchell Engineering Ltd.
New Conveyor Co. Ltd.
Spencer (Melksham) Ltd.
Strachan & Henshaw Ltd.
Richard Sutcliffe Ltd.

Spectrophotometers.
Beckman Instruments Inc.
Degenhardt & Co. Ltd.
Hilger & Watts Ltd.
A. Jobin & G. Yvon.

Spray nozzles.
Dei-Con Eastern Corporation.

Spraying and Dusting Machinery.
Cooper, Pegler & Co. Ltd.

Steam Storage Equipment.
British Boiler Accessories Ltd.
Cochran & Co., Annan, Ltd.
Duncan Stewart & Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Steam Superheaters.
Babcock & Wilcox Ltd.
Maschinenfabrik Buckau R. Wolf A.G.
Foster Wheeler Ltd.
John Thompson Water Tube Boilers Ltd.

Steam Turbines for Mill Drives, etc.
Belliss & Morcom Ltd.
George Cohen, Sons & Co. Ltd.
A. F. Craig & Co. Ltd.
Escher Wyss Ltd.
Soc Fives Lill-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.

Steel.
George Cohen, Sons & Co. Ltd.

Steel Bar and Wire.
Talbot Stead Tube Co. Ltd.

Steel Flooring and Handralling.
Grill Floors Ltd.
Open Steel Flooring Ltd.

Stokers—Bagasse Burning Spreader Type.
Babcock & Wilcox Ltd.

Sugar Factory Design and Erection (Cane and Beet).
Honolulu Iron Works Co.
Salzgitter Industriebau G.m.b.H.

Sugar Machinery, General.
Blairs Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Maschinenfabrik Buckau R. Wolf A.G.
A. F. Craig & Co. Ltd.

Sugar Machinery, General—*continued*
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honolulu Iron Works Co.
Kingston Industrial Works Ltd.
John McNeil & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
The Squier Corporation.
Duncan Stewart & Co. Ltd.
Stork-Werkspoor N.V. (V.M.F.).
Technoexport Czechoslovakia.
U.C.M.A.S.

Sugar Throwers and Trimmers.
Spencer (Melksham) Ltd.

Temperature Recorders and Controllers.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Evershed & Vignoles Ltd.
Kelvin Hughes (Industrial) Ltd.
Taylor Controls Ltd.

Thermometers.
The British Rototherm Co. Ltd.
Cambridge Instrument Co. Ltd.
Taylor Controls Ltd.

Track and Track Accessories.
Robert Hudson Ltd.
Krupp-Dolberg G.m.b.H.
N.V. Locospoor.
Railway Mine & Plantation Equipment Ltd.
Spoorijzer N.V. Delft.
U.S.I. International Divn., U.S. Industries Inc.

Tractors.
David Brown Industries, Tractor Divn.
Marshall Sons & Co. Ltd.

Trailers.
Cary Iron Works.
Robert Hudson Ltd.
Spoorijzer N.V. Delft.
Whitlock Brothers Ltd.

Trench Gratings.
Grill Floors Ltd.
Open Steel Flooring Ltd.

Tubes, Bi-Metal.
Talbot Stead Tube Co. Ltd
Yorkshire Imperial Metals Ltd.

Tubes for Boilers, Evaporators, Juice Heaters, Vacuum Pans, etc.
Hudson & Wright Ltd.
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.
Yorkshire Imperial Metals Ltd.

Tubes, Carbon, Alloy and Stainless Steel
Kirk & Co. (Tubes) Ltd.
Talbot Stead Tube Co. Ltd.

Tube Cleaners, *see* Scale Removal and Prevention.

Tube Fittings.
Blakey's Boot Protectors Ltd. (*malleable iron*).
Kirk & Co. (Tubes) Ltd. (*malleable iron and stainless steel*)
Talbot Stead Tube Co. Ltd. (*stainless steel*).
Yorkshire Imperial Metals Ltd. (*copper, brass and plastic*).

Tugs, Diesel-powered.
Fairmile Construction Co. Ltd.

Vacuum Pans, *see* **Pans.**

Vacuum Pumps.
Belliss & Morcom Ltd.
Blairs Ltd.
George Cohen, Sons & Co. Ltd.
Comet Pump & Engineering Co Ltd.
Cane Sugar Divn., Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
George Fletcher & Co. Ltd.
International Combustion (Export) Ltd.
The Mirrlees Watson Co. Ltd.
Ateliers Neyret Beylier.
A. & W. Smith & Co. Ltd.
Duncan Stewart & Co. Ltd.
Worthington-Simpson Ltd.

Valves.
David Brown Industries Ltd., Foundries Divn.
George Clark & Sons (Hull) Ltd.
George Cohen, Sons & Co. Ltd.
The Duriron Company, Inc.
Kirk & Co. (Tubes) Ltd.
The Lunkenheimer Company.
Saunders Valve Co. Ltd.
Talbot Stead Tube Co. Ltd.
Taylor Controls Ltd.

Variable Speed Controls.
Crofts (Engineers) Ltd.
Heenan & Froude Ltd.
Duncan Stewart & Co. Ltd.

Vehicle washes.
Grill Floors Ltd.

Water Cooling Towers.
Film Cooling Towers (1925) Ltd.
Foster Wheeler Ltd.
AB. Svenska Fläktfabriken.

Weighing Machines.
Adequate Weighers Ltd.
Butz & Leitz G.m.b.H.
Chronos Werk, Reuther & Reisert K.G.
Fr. Hesser Maschinenfabrik A.G.
Librawerk.
Richardson Scale Co. Ltd.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
see also **Juice Scales.**

Wire Cloth.
Ferguson Perforating & Wire Company.
Multi-Metal Wire Cloth Co. Inc.

Wrapping machines.
SAPAL.
SIG Swiss Industrial Company.

BUYERS' GUIDE—ADDRESS LIST

Activated Carbons & Chemicals Ltd.
Burnfield Road, Giffnock, Glasgow, Scotland.
Tel.: Merrylee 2393. *Cable* : Stedmacs, Giffnock.

Adequate Weighers Ltd.,
Bridge Works, Bridge Road, Sutton, Surrey, England.
Tel.: Vigilant 6666/7/8. *Cable* : Adegrate, London.

Alpine A.G.,
Göggінger Landstrasse 66, Augsburg 2, Germany.
Tel.: Augsburg 33033 *Cable* : Alpine, Augsburg.
Telex : 5 3802

The A.P.V. Co. Ltd., Chemical Engineering Division,
Manor Royal, Crawley, Sussex.
Tel. : Crawley 1360. *Cable* : Anaclastic, Crawley.
Telex : 8737

Ashworth & Parker Ltd.,
Riverside Works, Bury, Lancs., England.
Tel. : Bury 5125–6. *Cable* : Kinetic, Bury.

Associated Chemical Companies (Sales) Ltd.,
P.O. Box 6, Brotherton House, Westgate, Leeds 1, England.
Tel.: Leeds 29321/8. *Cable* : Aschem, Leeds.
Telex : 55–116.

Babcock & Wilcox Ltd.,
Babcock House, 209 Euston Rd., London, N.W.1, England.
Tel.: Euston 4321. *Cable:* Babcock, London.
Telex: 23256.

W. G. Bagnall Ltd.,
Castle Engine Works, Stafford, England.
Tel. : Stafford 321. *Cable* : Bagnall, Stafford.

W. & R. Balston Ltd.,
see H. Reeve Angel & Co. Ltd.

Andrew Barclay Sons & Co., Ltd.
Caledonia Works, Kilmarnock, Scotland.
Tel.: Kilmarnock 1366/7. *Cable:* Barclayson, Kilmarnock.

Beckman Instruments Inc.
Fullerton, California, U.S.A.
Tel.: Trojan 1–4848. *Cable* : Beckman, Fullerton.
Telex : Fullerton 5210.

Bellingham & Stanley Ltd.,
71 Hornsey Rise, London, N.19, England.
Tel. : Archway 2270. *Cable* : Polyfract, London.

Belliss & Morcom Ltd.,
Ledsam Street Works, Birmingham 16, England.
Tel. : Edgbaston 3531. *Cable* : Belliss, Birmingham 16.

Bennett, Sons & Shears Ltd.,
9–13 George Street, Manchester Square, London, W.1, Eng.
Tel. : Welbeck 8201–6 *Cable* : Cuprite, London.

F. W. Berk & Co. Ltd.,
Berk House, Portman Square, London, W.1.
Tel. : Hunter 6688. *Cable* : Berk, London.
Telex: 23796.

Birtley Engineering Ltd.,
Birtley, County Durham, England.
Tel.: Birtley 248/9. *Cable* : Birtley, Newcastle-upon-Tyne.

Blairs Ltd.,
Glasgow Engineering Works, Woodville Street, Govan, Glasgow, S.W.1, Scotland.
Tel. : Govan 1261 *Cable* : Blazon, Glasgow.

Blakey's Boot Protectors Ltd.,
see Pennine Chainbelt Co. Ltd.

BMA Braunschweigische Maschinenbauanstalt,
(20b) Braunschweig, Bahnhofstrasse 5, Germany.
Tel. : Braunschweig 23691. *Cable* : Bema, Braunschweig
Telex : Bema Bswg. 0952840

William Boulton Ltd.,
Providence Engineering Works, Burslem, Staffs., England.
Tel.: Stoke-on-Trent 88661. *Cable:* Boultons, Burslem.

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol 5, England.
Tel.: Bristol 58222. *Cable:* Bremaners, Bristol.

British Boiler Accessories Ltd.
62/63 Fenchurch Street, London E.C.3., England.
Tel.: Royal 4122/6305. *Cable* : Boileracs, London.

British Ropes Ltd.,
Leith, Edinburgh 6, Scotland.
Tel.: Leith 36811. *Cable:* Roperie, Leith.
Telex: 72338.

The British Rototherm Co. Ltd.,
Merton Abbey, London S.W.19, England.
Tel.: Liberty 7661. *Cable:* Rototherm, London.

Thomas Broadbent & Sons Ltd.,
Central Ironworks, Huddersfield, England.
Tel : Huddersfield 5520. *Cable* : Broadbent, Huddersfield.

J. Brockhouse & Co. Ltd.,
Victoria Works, Hill Top, West Bromwich, Staffs., England.
Tel. : Wednesbury 0243.
Cable : Brockhouse, West Bromwich.

Broussard Machine Company,
see Logan Perkins.

David Brown Corporation (Sales) Ltd.,
96/97 Piccadilly, London, W.1, England.
Tel. : Grosvenor 5271. *Cable* : Davibron, London

David Brown Industries Ltd., Coventry Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Foundries Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., General Gear Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Jackson Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Radicon Division,
see David Brown Corporation (Sales) Ltd.

David Brown Industries Ltd., Tractor Division,
see David Brown Corporation (Sales) Ltd.

Maschinenfabrik Buckau R. Wolf A.G.,
Grevenbroich/Ndrrh., Germany.
Tel. : Grevenbroich 1481.
Cable : Maschinenbau, Grevenbroich.
Telex : 08517111.

Buell (1952) Ltd.,
3 St. James's Square, London, S.W.1, England.
Tel. : Trafalgar 2528. *Cable* : Allentare, London.

Buhler Brothers,
Uzwil, Switzerland.
Tel.: 65212 Uzwil *Cable* : Buhler, Uzwil.
Telex : 57902

Büttner-Werke A.G.,
Postfach 59, Krefeld-Uerdingen 1, Germany.
Tel.: Krefeld 43511. *Cable:* Büttner, Krefeld-Uerdingen.

Buttner Works Inc.
52 Vanderbilt Avenue, New York 17, N.Y., U.S.A.
Tel.: Murray Hill 9–5098. *Cable* : Buttnerusa, New York.

Buttner Works (Canada) Ltd.,
P.O. Box 688, Montreal, Quebec, Canada.
Tel.: RE–7–9053 *Cable* : Buttner, Montreal.

Butz & Leitz G.m.b.H.,
(22b) Ludwigshafen a. Rh., Industriestrasse, Germany.
Tel.: Ludwigshafen 63618/9, 64003.
Cable : Butzleitz, Ludwigshafenrhein.

Cambridge Instrument Co. Ltd.,
13 Grosvenor Place, London S.W.1., England.
Tel.: Belgravia 5066. *Cable :* Unipivot, London.

Hugh Campbell (London) Ltd.,
Kent House Lane, Beckenham, Kent, England.
Tel.: Sydenham 8178, 8238. *Cable:* Mechandle, Beckenham.

The Cape Asbestos Co. Ltd.,
114 & 116 Park Street, London, W.1., England.
Tel.: Grosvenor 6022. *Cable:* Incorrupt, London.

Cary Iron Works,
see Logan Perkins.

Catchpole Engineering Co. Ltd.,
19 Hatter Street, Bury St. Edmunds, Suffolk, England.
Tel.: Bury St. Edmunds 2591.
Cable: Beslift, Bury St. Edmunds

C.E.C.A.,
24 Rue Murillo, Paris 8e, France.
Tel. · Car 8200. *Cable :* Ceca, Paris.

Chambon Ltd.,
Riverside Works, Standish Road, London W.6., England.
Tel.: Riverside 6086. *Cable:* Chambonted, London.

Choquenet L. Fonderies et Ateliers—Sté. Ame,
Chauny (Aisne), France.
Tel. Chauny 34.

Chronos Werk, Reuther & Reisert K.G.,
Hennef-Sieg (Rhld), Germany.
Tel.: Sa. Nr. 881/3. *Cable :* Chronos, Hennefsieg.
Telex : 8/869224

George Clark & Sons (Hull) Ltd.,
Hawthorn Avenue, Hull, England.
Tel.: Hull 37654. *Cable:* Clark, Hull.

The Clydesdale Chemical Co. Ltd.,
105 Millerston Street, Glasgow, E.1, Scotland.
Tel. : Bridgeton 4374. *Cable :* Cactus, Glasgow

Cochran & Co., Annan, Ltd.,
Annan, Dumfriesshire, Scotland.
Tel : Annan 111. *Cable :* Multitube, Annan.

Cocksedge & Co. Ltd.,
Grey Friars Road, Ipswich, Suffolk, England.
Tel.: Ipswich 56161. *Cable:* Cocksedge, Ipswich.

George Cohen, Sons & Co. Ltd.,
58 Wood Lane, London, W.12, England.
Tel. : Shepherds Bush 2070. *Cable :* Omniplant, London.
Telex : 2–2461.

Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, England.
Tel. : Thornton Heath 3816. *Cable :* Comet, Croydon.

Cooper, Pegler & Co. Ltd.,
P.O. Box 9–98, Burgess Hill, Sussex, England.
Tel.: Burgess Hill 2525. *Cable :* Stomata, Burgess Hill.

Cotton Bros. (Longton) Ltd.,
Crown Works, Portland Road, Longton, Stoke-on-Trent, Staffs., England.
Tel.: Longton 33021. *Cable:* Cotbro, Stoke-on-Trent.

A. F. Craig & Co. Ltd..
Caledonia Engineering Works, Paisley, Scotland.
Tel. : Paisley 2191. *Cable :* Craig, Paisley.

Crofts (Engineers) Ltd.,
Thornbury, Bradford 3, Yorkshire, England.
Tel. : Bradford 65251. *Cable :* Crofters, Bradford.
Telex : 51186.

James A. Cuthbertson Ltd.,
Station Road, Biggar, Lanarkshire, Scotland.
Tel.: Biggar 20. *Cable:* Mechadrain, Biggar.

Dallow, Lambert & Co. Ltd.,
Thurmaston, Leicester, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.

Davey, Paxman & Co. Ltd.,
Standard Iron Works, Colchester, Essex, England.
Tel. : Colchester 5151. *Cable :* Paxman, Colchester.
Telex : 1875.

Degenhardt & Co. Ltd.,
6 Cavendish Square, London W.1., England.
Tel.: Langham 6097/9.

Dei-Con Eastern Corporation,
Eastern Hemisphere Export Sales Divn., The Deister Concentrator Co. Inc.,
60 Beaver St., New York 4, N.Y., U.S.A.
Tel.: Digby 4–7389. *Cable :* Retsied, New York.

Dicalite Department, Great Lakes Carbon Corp.,
18 East 48th Street, New York 17, N.Y., U.S.A.
Tel. : Eldorado 5–6200. *Cable :* Dicalite, New York.

Cane Sugar Division, Dorr-Oliver Inc.,
Stamford, Conn., U.S.A.

The Drewry Car Co. Ltd.,
City Wall House, 129/139 Finsbury Pavement, London E.C.2., England.
Tel.: Monarch 0671. *Cable :* Inneal, London.

Dunford & Elliott Process Engineering Ltd.,
Linford Street, London, S.W.8, England.
Tel. : Macaulay 2405. *Cable :* Lindaresco, London

The Duriron Company Inc.,
450 N. Findlay Street, Dayton 1, Ohio, U.S.A.
Tel. : Clearwater 4–5344.

Edwards Engineering Corp.,
715 Camp Street, New Orleans 12, La., U.S.A.
Tel. : Tulane 0175. *Cable :* Joedco, New Orleans.

Eimco (Great Britain) Ltd.,
Earlsway, Team Valley, Gateshead 11, England.
Tel. : Low Fell 7–7241. *Cable :* Eimco, Gateshead

Electroflo Meters Co. Ltd.,
Abbey Road, Park Royal, London, N.W.10, England.
Tel.: Elgar 7641. *Cable:* Elflometa, London.
Telex: 2–3196.

Electromagnets Ltd.,
Boxmag Works, Bond St., Hockley, Birmingham, England.
Tel.: Central 5391–3. *Cable:* Boxmag, Birmingham.

Enzinger Division, The Duriron Company Inc.,
P.O. Box 71, Angola, New York, U.S.A.
Tel. : Angola 188.

Escher Wyss Ltd.,
Terminal House, 52 Grosvenor Gardens, London, S.W.1, England.
Tel. : Sloane 8101. *Cable :* Escherwyss, London.

Evenproducts, Evesham,
Evesham, Worcestershire, England.
Tel.: Evesham 2547 *Cable :* Evenproducts, Evesham.

Eversheds & Vignoles Ltd.,
Chiswick, London, W.4, England.
Tel. : Chiswick 3670. *Cable :* Megger, London.
Telex : 22–583.

Ewart Chainbelt Co. Ltd.,
Colombo Street, Derby, England.
Tel. : Derby 45451. *Cable :* Chainbelt, Derby.

Fairmile Construction Co. Ltd.,
Cobham, Surrey, England.
Tel.: Cobham 400. *Cable :* Faircraft, Cobham.

Farnell Carbons Ltd.,
Conduit Road, Plumstead, London, S.E.18, England.
Tel.: Woolwich 1158. *Cable :* Scofar, London.

Farrel-Birmingham Co. Inc.,
Ansonia, Conn., U.S.A.
Tel.: Regent 4–3331.

Farrow & Sons Ltd.,
Spalding, Lincs., England.
Tel.: Spalding 3388. *Cable:* Farrows, Spalding.

Ferguson Perforating & Wire Co.,
130–140 Ernest Street, Providence, R.I., U.S.A.
Tel. : Williams 1–8876. *Cable :* Ferguson, Providence.

Film Cooling Towers (1925) Ltd.,
Lionel Road, Kew Bridge, Brentford, Middx., England.
Tel.: Chiswick 2953/4/5. *Cable :* Aloof, London.

Société de Fives Lille-Cail,
7 Rue Montalivet, Paris 8e, France.
Tel. : Anjou 22–01. *Cable :* Fiville, Paris.

George Fletcher & Co. Ltd.,
Masson Works, Litchurch Lane, Derby, England.
Tel. : Derby 45817. *Cable :* Amarilla, Derby.

Flexible Drives (*Gilmans*) Ltd.,
Carlton House, High Street, Smethwick, Staffs., England.
Tel. : Smethwick 1202. *Cable :* Skatoskalo, Birmingham.

Flexotube (Liverpool) Ltd.,
25, Hope Street, Liverpool 1, England.
Tel.: Royal 3345. *Cable :* Flexotube, Liverpool.

Fontaine & Co.,
Aachen, Germany.

T. B. Ford Ltd.,
30 New Bridge Street, London E.C.4., England.
Tel.: City 2272. *Cable :* Fordfilt, London.

Foster Wheeler Ltd.,
3 Ixworth Place, London, S.W.3, England.
Tel. : Kensington 6363. *Cable :* Rewop, London.
Telex : London 23442.

The Fullers' Earth Union Ltd.,
Patteson Court, Nutfield Road, Redhill, Surrey, England.
Tel.: Redhill 3521. *Cable:* Fullion, Redhill.

William Gardner & Sons (Gloucester) Ltd.,
Bristol Road, Gloucester, England.
Tel.: Gloucester 21261. *Cable:* Gardner, Gloucester.

The Geigy Company Ltd.,
Rhodes, Middleton, Manchester, England.
Tel. : Middleton 3644. *Cable :* Geigy, Middleton.

The General Chemical & Pharmaceutical Co. Ltd.,
Judex Works, Sudbury, Wembley, Middx., England.
Tel.: Arnold 3883. *Cable :* Chemipharm, Wembley.

General Refractories Ltd.,
Genefax House, Tapton Park Road, Sheffield 10, Yorkshire, England.
Tel.: Sheffield 31113. *Cable:* Genefax, Sheffield.
Telex: 54–128.

Great Lakes Carbon Corp., *see* Dicalite Department.

E. Green & Son Ltd.,
Economiser Works, Wakefield, England.
Tel. : Wakefield 2706. *Cable :* Economiser, Wakefield.

Grill Floors Ltd.
West Row, North Kensington, London W.10., England.
Tel.: Ladbroke 3066/7 *Cable :* Etyladec, London.

Gruendler Crusher & Pulverizer Co.,
2915 North Market Street, St. Louis 6, Mo., U.S.A.
Tel. : Jefferson 1–1220. *Cable :* Grupulco, St. Louis.

Gutehoffnungshütte Sterkrade A.G.,
Werk Düsseldorf, Düsseldorf, Germany.

D. W. Haering & Co. Inc.,
P.O. Box 10337, San Antonio 21, Texas, U.S.A.
Tel.: Walnut 2–1235. *Cable :* H–O–H, San Antonio.

The Harland Engineering Co. Ltd.,
Harland House, 20 Park Street, London W.1.
Tel.: Grosvenor 1221/3.
Telex : 22881

G. M. Hay & Co. Ltd.,
Strathclyde Foundry, 42 Fore Street, Whiteinch, Glasgow, W.4, Scotland.
Tel. : Scotstoun 4390. *Cable :* Castiron, Glasgow.

Heath Filtration Ltd.,
Sneyd Mills, Newcastle Street, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 84698/87172.

G. H. Heath & Son (1952) Ltd.,
Heathcote and Greenhead Works, Burslem, Stoke-on-Trent, Staffs., England.
Tel.: Stoke-on-Trent 87273/4/5. *Cable:* Durability, Burslem.

Heenan & Froude Ltd.,
Worcester, England.
Tel. : Worcester 3461. *Cable :* Heenan, Worcester.

Hein, Lehmann & Co. A.G.,
Abt. Massentrennung, P.O. Box 9107, Düsseldorf, Germany.
Tel.: 70201 *Cable :* Herrmannsieb, Düsseldorf.

Fr. Hesser Maschinenfabrik A.G.
Stuttgart-Bad Cannstatt, Nauheimerstr. 99, Germany.
Tel.: Stuttgart 53341. *Cable:* Hesser, Stuttgart-Bad Cannstatt. *Telex :* 072-2362

F. C. Hibberd & Co. Ltd.,
56 Victoria St., London S.W.1., England.
Tel.: Victoria 9517/8. *Cable :* Planetloco, London.

Hilger & Watts Ltd.,
98 St. Pancras Way, Camden Rd., London, N.W.1, England.
Tel. : Gulliver 5636. *Cable :* Sphericity, London.
Telex : 23852.

Samuel Hill Ltd.,
Lark Mill, Hare Street, Rochdale, Lancashire, England.
Tel. : Rochdale 2273. *Cable :* Filtering, Rochdale

Hinz Elektromaschinen und Apparatebau,
(20b) Braunschweig, Frankfurter Str. 1a, Germany.
Tel. : Braunschweig 25533/4. *Cable :* Hinzmotoren, Braunschweig.
Telex : 0952753.

Honolulu Iron Works Co.,
165 Broadway, New York 6, N.Y., U.S.A.
Cable : Honiron, New York

Robert Hudson Ltd.,
Raletrux House, Meadow Lane, Leeds, England.
Tel. : Leeds 20004. *Cable :* Raletrux, Leeds.

Hudson & Wright Ltd.,
Halberton Street, Birmingham 18, England.
Tel.: Smethwick 0675/6. *Cable* : Desac, Birmingham.

Hudswell, Clarke & Co. Ltd.,
14 Howick Place, Victoria Street, London, S.W.1., England
Tel.: Victoria 6786. *Cable:* Hudclar, London.

Hunslet Engine Co. Ltd.,
125 Jack Lane, Leeds 10, Yorkshire, England.
Tel. : Leeds 32261. *Cable :* Engine, Leeds.

IMACTI, Industrieele Maatschappij Activit N.V.,
Postbus 240c, Amsterdam, Holland.
Tel. : 60153. *Cable :* Activit, Amsterdam.

International Combustion (Export) Ltd.,
19 Woburn Place, London, W.C.1, England.
Tel. : Terminus 2833. *Cable :* Lopulco, London.

Isopad Ltd.,
Barnet By-Pass, Boreham Wood, Herts., England.
Tel.: Elstree 2817/9. *Cable:* Isopad, Boreham, Wood

A. Jobin & G. Yvon,
26 Rue Berthollet, Arcueil (Seine), France.
Tel.: Alésia 58–54.

Johns-Manville International Corp.,
22 East 40th Street, New York 16, N.Y., U.S.A.
Tel.: Lexington 2–7600. *Cable:* Johnmanvil, New York

S. H. Johnson & Co. Ltd.,
Carpenters Road, Stratford, London, E.15, England.
Tel.: Maryland 7431. *Cable:* Filtrum, London.

Thomas C. Keay Ltd.,
Baltic Street, Dundee, Scotland.
Tel.: Dundee 26031/4 *Cable:* Keay, Dundee.

Kek Ltd.,
Palmerston Street, Ancoats, Manchester 12, England.
Tel.: Ardwick 1104/5. *Cable:* Kekgrind, Manchester 12.

Kelvin & Hughes (Industrial) Ltd.,
Kelvin House, Wembley Park, Middlesex, England.
Tel.: Wembley 8888. *Cable:* Kelhue, Wembley.

William Kenyon & Sons Ltd.,
Dukinfield, Cheshire, England.
Tel.: Ashton-u-Lyne 1614 7. *Cable:* Kenyon, Dukinfield.

John King & Co. (Leeds) Ltd.,
Garnet Road, Leeds 11, Yorkshire, England.
Tel.: Leeds 75414. *Cable:* Malleable, Leeds.

Kingston Industrial Works Ltd.,
P.O. Box 72, Kingston, Jamaica, W.1.

Kirk & Co. (Tubes) Ltd.,
74/82 Paradise Street, London S.E.16, England.
Tel.: Bermondsey 3156/9. *Cable:* Kirflanges, London.

The Kleen-e-ze Brush Co. Ltd.,
Hanham, Bristol, England.
Tel.: Bristol 73027. *Cable:* Kleeneze, Bristol.

Köllmann & Gruhn,
Auf der Bleiche 9, Wuppertal-Oberbarmen, Germany.
Tel.: Wuppertal 598 808. *Cable:* Köllmannwerk, Wuppertal
Telex: 08512–774.

Krauss-Maffei-Imperial G.m.b.H. & Co.,
München-Obermenzing, Tannenweg 4, Germany.
Tel.: München 65 996. *Cable:* Imperial, München.
Telex: 052 3277.

Ets Krieg et Zivy,
9 Rue Louis-Lejeune, Montrouge (Seine), France.
Tel.: ALEsia 40–80. *Cable:* Krieg Zivy, Montrouge.

Krupp-Dolberg G.m.b.H.,
Essen, Germany.
Tel.: 21361 Essen. *Cable:* Dolberg, Essen.
Telex: 0857 732 dolberg

Lafarge Aluminous Cement Co. Ltd.,
73 Brook Street, London, W.1, England.
Tel.: Mayfair 8546. *Cable:* Cimenfondu, London.

Lancashire Dynamo & Crypto Ltd.,
St. Stephen's House, Victoria Embankment, London, S.W.1.
Tel.: Whitehall 7211–5. *Cable:* Umformer, London.
Telex: 23880.

Lancashire Dynamo Electronic Products Ltd.,
see Lancashire Dynamo & Crypto Ltd.

The Leeds Fireclay Co. Ltd.,
Wortley, Leeds 12, Yorkshire, England.
Tel.: Leeds 638021. *Cable:* Fireclay, Wortley, Leeds.

Lepage, Urbain & Cie.,
105 Rue de la Convention, Paris 15e, France.
Tel.: Lecourbe 50–02. *Cable:* Alepage, Paris.

Librawerk,
Vossenkamp 1, Braunschweig, Germany.
Tel.: Sammel-Nr. 30851. *Cable:* Librawerk, Braunschweig.
Telex: 0952866.

Link-Belt Company, Department 1258–ISJL,
2650 Woolworth Building, New York 7, N.Y., U.S.A.
Tel.: Digby 9–4210. *Cable:* Linkbelt, New York.

N.V. Locospoor,
78 Bezuidenhout, The Hague, Holland.
Tel.: 720737. *Cable:* Locospoor, The Hague.

The Lunkenheimer Company,
Cincinnati 14, Ohio, U.S.A.
Cable: Lunken, Cincinnati.

LURGI Gesellschaft für Chemotechnik m.b.H.,
Frankfurt/Main, Lurgihaus, Leerbachstrasse 72/74, Germany.
Tel.: 55–05–51. *Cable:* Lurgitechnik, Frankfurt.
Telex: 04–11108.

Lyddon & Co. Ltd.,
18/19 Savile Row, London, W.1, England.
Tel.: Regent 7321/9. *Cable:* Lyddexpor, London.
Telex: 2–2491

John McNeil & Co. Ltd.,
Colonial Iron Works, Helen St., Govan, Glasgow, S.W.1, Scotland.
Tel.: Govan 1246. *Cable:* Colonial, Glasgow.

Macherey, Nagel & Co., Inh. Dr. Ing. Adolf Radmacher,
Düren–Rhld., Postschliessfach 307, Germany.
Tel.: Düren 6169. *Cable:* Manapapier, Düren.

Marco Conveyor & Engineering Co. Ltd.,
Rowin Works, Lynn Road, Leytonstone, London, E.11, England.
Tel.: Leytonstone 2254/5. *Cable:* Engimarco, London.

Markham Traction Ltd.,
Lincolnshire Ironworks, Stamford, Lincoln, England.
Tel.: Stamford 2226. *Cable:* Marktrac, Stamford.

Marshall, Sons & Co. Ltd.,
Gainsborough, Lincs., England.
Tel.: Gainsborough 2301. *Cable:* Marshalls, Gainsborough.

Martin's Cultivator Co. Ltd., *see* Markham Traction Ltd.

Mechans Ltd.,
Scotstoun Iron Works, Glasgow W.4, Scotland.
Tel.: Scotstoun 2211. *Cable:* Nautical, Glasgow.
Telex: 77–234.

Metal Detection Ltd.,
Moseley Street, Birmingham 12, England.
Tel.: Victoria 0211. *Cable:* Metection, Birmingham.

The Mirrlees Watson Co. Ltd.,
45 Scotland Street, Glasgow, C.5, Scotland.
Tel.: South 2701. *Cable:* Mirrlees, Glasgow.

L. A. Mitchell Ltd.,
Harvester House, 37 Peter Street, Manchester 2, England.
Tel.: Blackfriars 7224. *Cable:* Inspection, Manchester.

Mitchell Engineering Ltd.,
1 Bedford Square, London W.C.1., England.
Tel.: Museum 5511. *Cable:* Micontraco, London.
Telex: 23450.

Mono Pumps Ltd.,
Mono House, Sekforde Street, Clerkenwell Green, London, E.C.1, England.
Tel.: Clerkenwell 8911. *Cable:* Monopumps, London.

Multi-Metal Wire Cloth Co. Inc.,
1350 Garrison Avenue, Bronx 59, N.Y., U.S.A.
Tel.: Kilpatric 22500. *Cable:* Multimetal, New York.

The New Conveyor Co. Ltd.,
Brook Street, Smethwick, Birmingham 40, England.
Tel.: Smethwick 2100. *Cable:* Aptitude, Birmingham.

Ateliers Neyret Beylier,
Boîte Postale 48, Grenoble (Isère), France.
Tel.: Grenoble 44–73.80. *Cable:* Neyret, Grenoble

N.V. Norit-Vereeniging Verkoop Centrale,
2de Weteringplantsoen 15, Amsterdam C, Holland.
Tel.: Amsterdam 39911. *Cable:* Noritcarbo, Amsterdam.

Etablissements A. Olier,
12 Avenue George-V, Paris, France.
Tel.: Elysées 27–30. *Cable:* Androlier, Paris

Open Steel Flooring Ltd.,
Tavistock House North, Tavistock Square, London W.C.1., England.
Tel.: Euston 6201.

Orenstein & Koppel Ltd.,
31 Finsbury Square, London E.C.2., England.
Tel.: Monarch 4615. *Cable:* Orenkopp, London.

Parsons Chain Co. Ltd.,
Stourport-on-Severn, Worcestershire, England.
Tel.: Stourport 2551. *Cable:* Chainwork, Stourport-on-Severn.

The Paterson Engineering Co. Ltd.,
129 Kingsway, London, W.C.2, England.
Tel.: Holborn 8787. *Cable:* Cumulative, London.

Pennine Chainbelt Co. Ltd.,
Modder Place, Armley, Leeds 12, England.
Tel.: Leeds 63–8755. *Cable:* Pennine, Leeds.

Logan Perkins,
International Trade Mart., New Orleans, La., U.S.A.
Cable: Perco, New Orleans.

Permag Ltd.,
see Rapid Magnetic Machines Ltd.

The Permutit Co. Ltd.,
Permutit House, Gunnersbury Avenue, London, W.4, England.
Tel.: Chiswick 6431. *Cable:* Permutit, London.

Filtres Philippe S.A.,
109 Blvd. Henri-Barbusse, (P.O. Box 30) Houilles (S. & O.), France.
Tel.: 961–79–90. *Cable:* Alfilipe, Houilles.
Telex: 2–3–155.

H. Pontifex & Sons Ltd.,
see Bennett, Sons & Shears Ltd.

Pott, Cassels & Williamson Ltd.,
Motherwell, Scotland.
Tel.: Motherwell 22. *Cable:* Pott, Motherwell.

The Power-Gas Corporation Ltd.,
Parkfield Works, Stockton-on-Tees, Co. Durham, England.
Tel.: Stockton-on-Tees 67161.
Cable: Tetratomic, Stockton-on-Tees.
Telex: 58–530.

Power Plant Co. Ltd.,
West Drayton, Middlesex, England.
Tel.: West Drayton 2626. *Cable:* Roc, West Drayton.

H. Putsch & Comp.,
Postfach, Frankfurter Str. 5–25, Hagen/Westfalen, Germany.
Tel.: Hagen 22341. *Cable:* Putsch, Hagenwestf.
Telex: 0823/795.

Railway Mine & Plantation Equipment Ltd.,
Imperial House, Dominion Street, London, E.C.2., England.
Tel.: Monarch 7000. *Cable:* Minplan, London.
Telex: 23787

Ransome & Marles Bearing Co. Ltd.,
Newark-on-Trent, Notts., England.
Tel.: Newark 456. *Cable:* Bearings, Newark.
Telex: 37–626

Ransomes Sims & Jefferies Ltd.,
Orwell Works, Ipswich, England.
Tel.: Ipswich 54711. *Cable:* Ransomes, Ipswich.
Telex: 1874.

Rapid Magnetic Machines Ltd.,
Lombard Street, Birmingham 12, England.
Tel.: Victoria 1137. *Cable:* Magnetism, Birmingham.

Redler Conveyors Ltd.,
Dudbridge Works, Stroud, Glos., England.
Tel.: Stroud 1604/8. *Cable:* Redler, Stroud.

H. Reeve Angel & Co. Ltd.,
9 Bridewell Place, London, E.C.4, England.
Tel.: Fleet Street 9833. *Cable:* Papermen, London.
Telex: 23812, Stasaleco.

Machinefabriek Reineveld N.V.,
P.O. Box 22, Haagweg 127, Delft, Holland.
Tel.: Delft 24890. *Cable:* Reineveld, Delft.
Telex: 31027.

Richardson Scale Co. Ltd.,
Albert Street, Bulwell, Nottingham, England.
Tel.: Bulwell 27–8558. *Cable:* Richscalco, Nottingham.

Riedel-de Haën A.G.
Seelze Hannover, Germany.
Tel.: Seelze 601. *Cable:* Riedelag Seelze.
Telex: 922748.

Rohm & Haas Company,
Washington Square, Philadelphia 5, Pa., U.S.A.
Tel.: Walnut 5–9860. *Cable:* Oropon, Philadelphia.

Rotameter Manufacturing Co. Ltd.,
330 Purley Way, Croydon, Surrey, England.
Tel.: Croydon 3816. *Cable:* Rotaflo, Croydon

Rotary Hoes Ltd.,
West Horndon, Essex, England.
Tel.: Herongate 361. *Cable:* Rotavator, Brentwood.

Russell Constructions Ltd.,
Russell House, Adam Street, Adelphi, London W.C.2, England.
Tel.: Temple Bar 0055/9. *Cable:* Russelcon, London.

Sackfilling & Sewing Machine Syndicate Ltd.,
Timewell Works, Lockfield Avenue, Brimsdown, Enfield, Middlesex, England.
Tel.: Howard 1188. *Cable:* Fecit, Enfield.

Salzgitter Industriebau G.m.b.H.,
Salzgitter-Drütte, Braunschweig, Germany.
Tel.: Salzgitter-Immendorf 5411.
Cable: Hüttenbau, Braunschweig.
Telex: 0952837/38.

Salzgitter Maschinen Aktiengesellschaft,
Salzgitter-Bad, Western Germany.
Tel.: Salzgitter 3441. *Cable:* Samag, Salzgitter-Bad.

Sandvik Steel Band Conveyors Ltd.,
Dawlish Road Works, Selly Oak, Birmingham 29, England.
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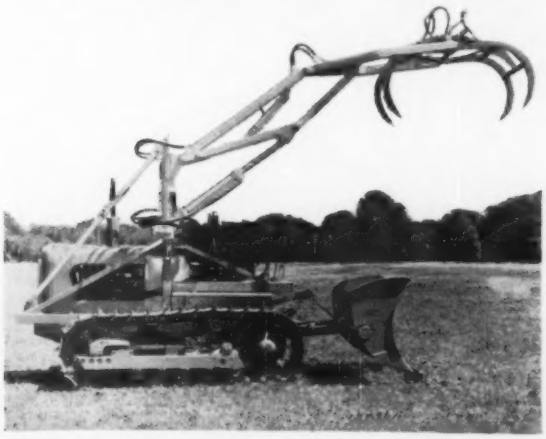

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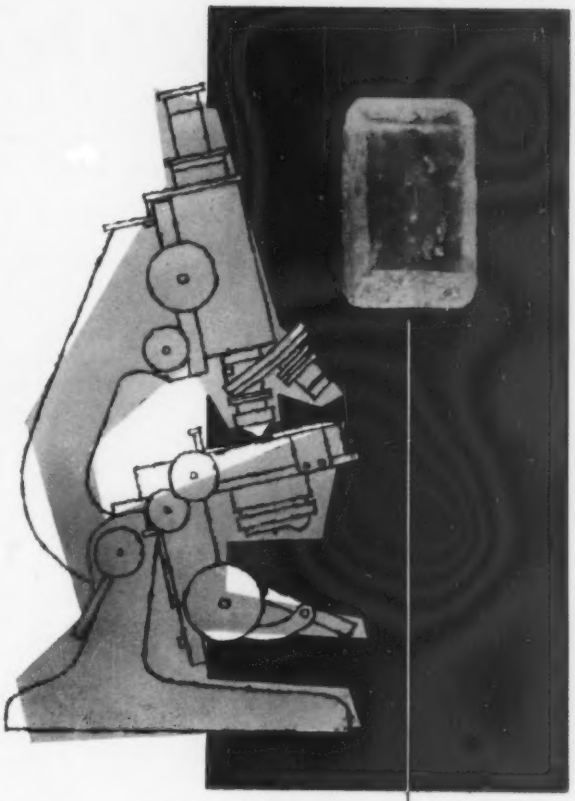

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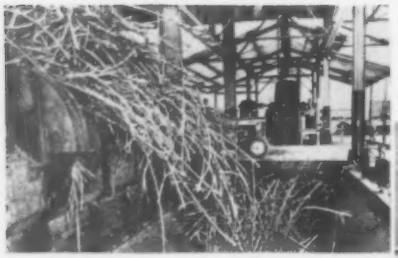

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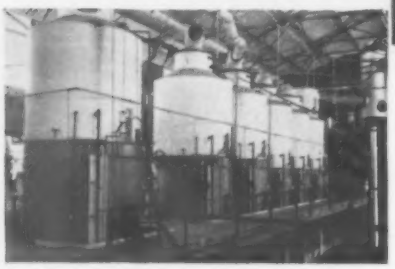

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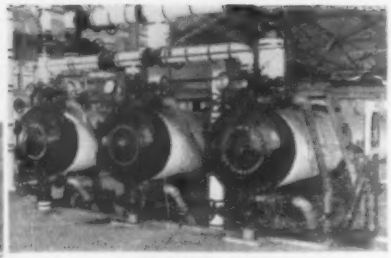

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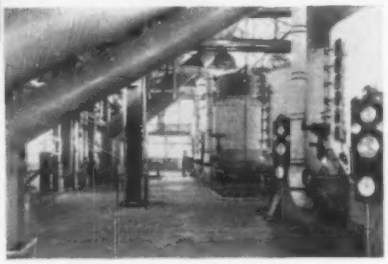

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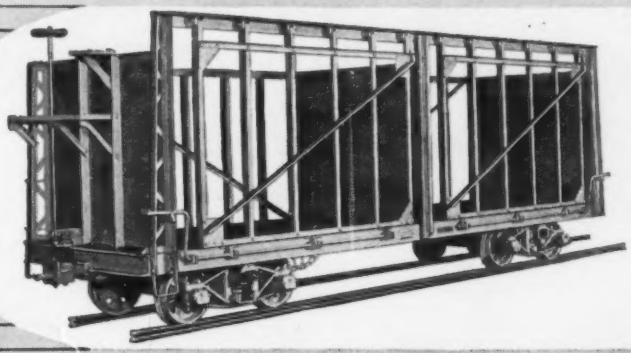

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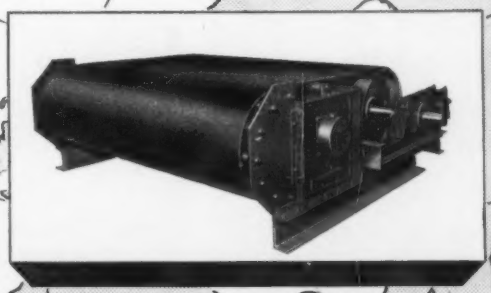

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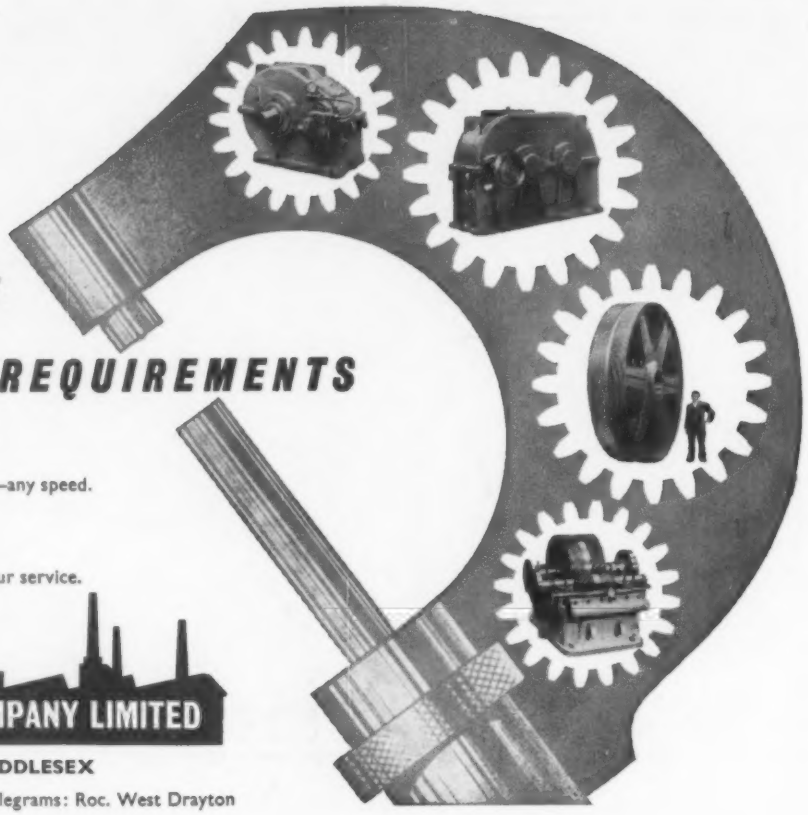

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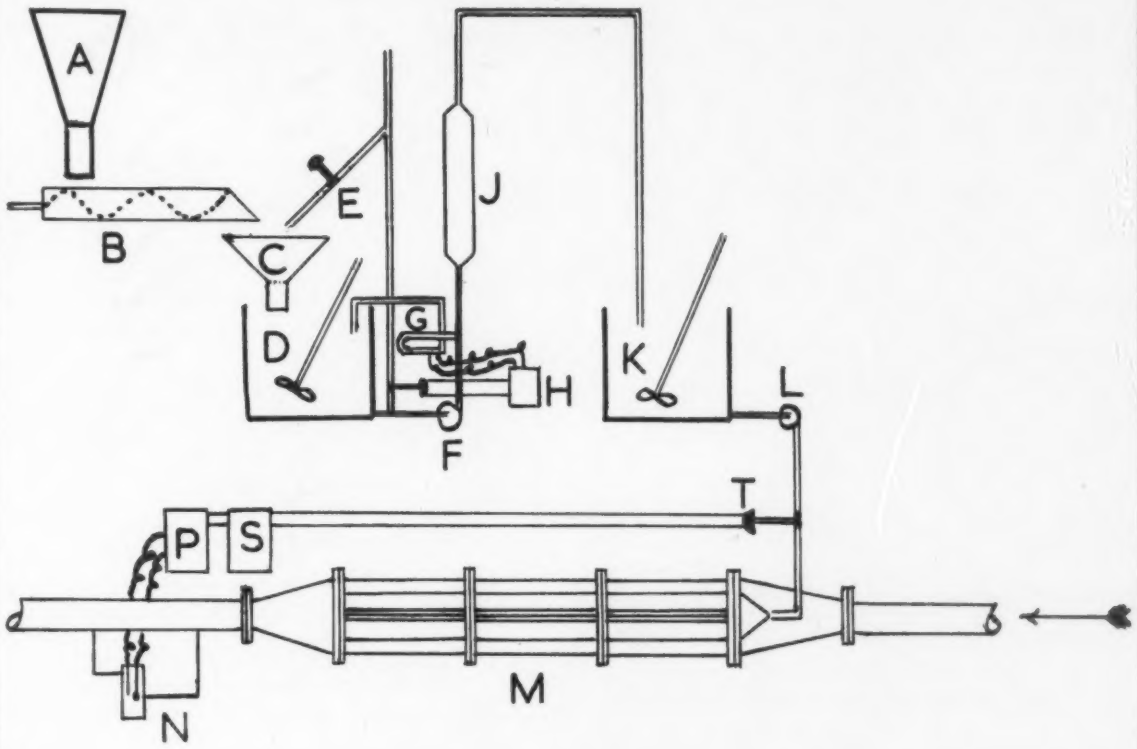

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B—Screw Conveyor

C—Sieve-bottom Receiver Hopper.

D—Heavy Milk-of-Lime Tank with Stirrer.

E—Hand Operated Valve on Water Line.

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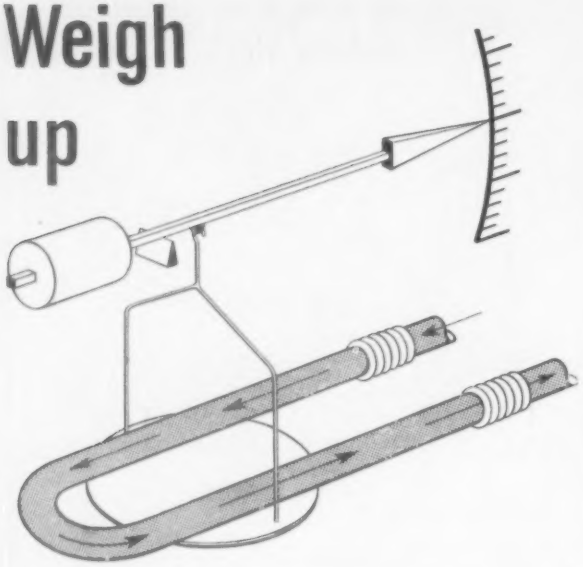

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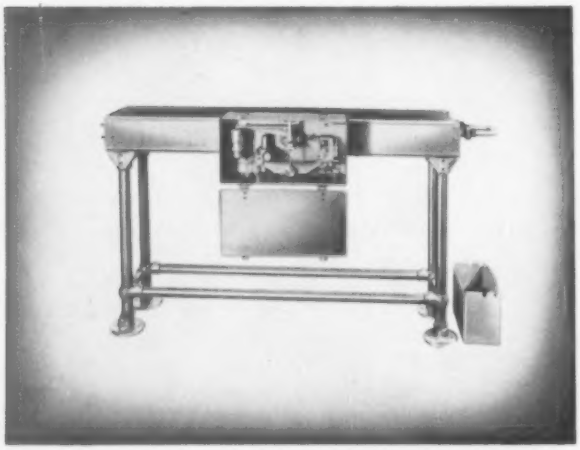

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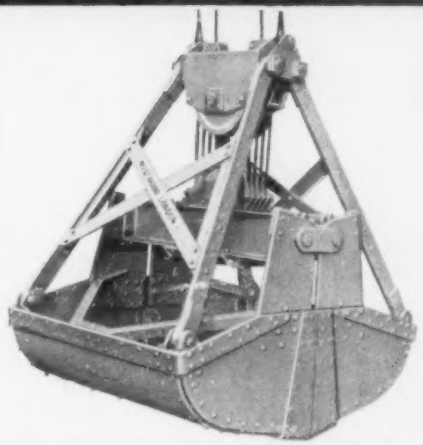

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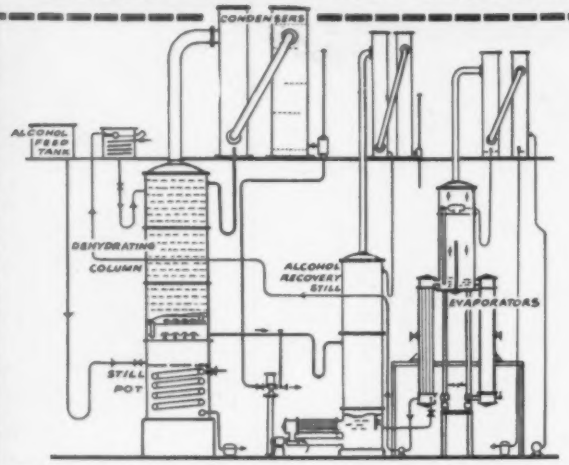

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108. Bulhoes	Brazil	14
109. Grand Bois	Reunion	24
110. La Providencia	Argentina	26
111. La Corona	Argentina	26
112. Manuelita	Columbia	22
113. Rio Haina	Dom. Rep.	26
114. Romana	Dom. Rep.	30
115. Ozama	Dom. Rep.	20
116. San Carlos	Ecuador	20
117. Constance	Mauritius	24
118. Cuatotolapam	Mexico	24
119. Sugar Planters	Tanganyika	22
120. Triangle Sugar	Southern Rhodesia	16
121. Umhlume	Swaziland	24
122. La Estrella	Panama	20
123. Mon Desert	Mauritius	30
124. El Potrero	Mexico	22
125. Consuelo	Dom. Rep.	32
126. Azucarera Nacional	Panama	19
127. La Belgica	Bolivia	22
128. Umfolozi Sugar	So. Africa	24
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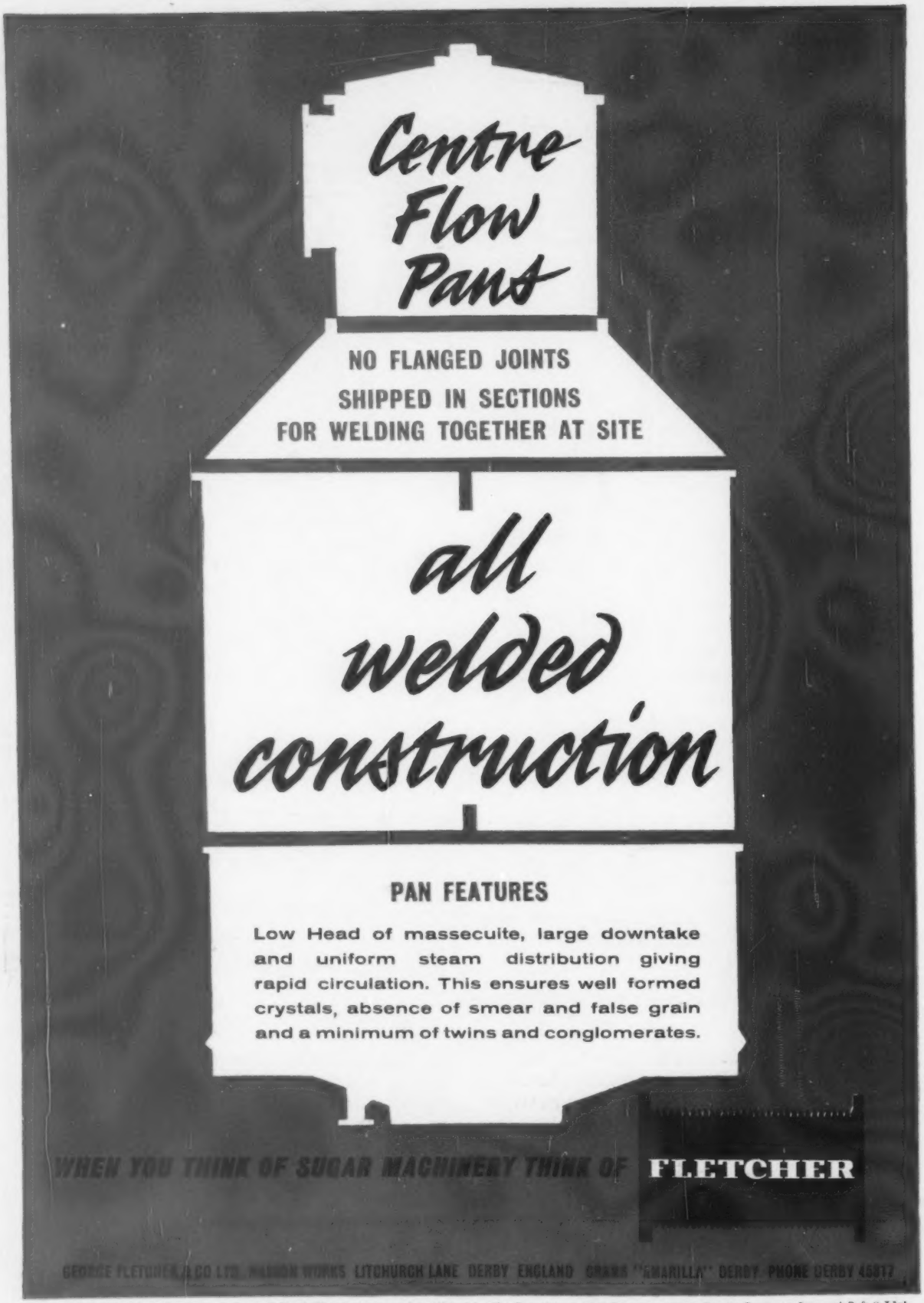
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PRINTED IN GREAT BRITAIN.